King County Reclaimed Water Assistance Program

Auburn/Kent Valley Water Reuse Project

PREPARED FOR: Tom Fox, KCDNR

PREPARED BY: Bill Persich, Brown and Caldwell
Dave Parkinson, CH2M HILL

COPIES Rick Kirkby, KCDNR
Greg Bush, KCDNR
John Smyth, KCNDR

DATE: August 15, 2000

REVISED: August 30, 2000

Background

As a part of the Regional Wastewater Services Plan status reporting, the King County Executive will be developing a reclaimed water work plan and providing that plan, along with the annual status report, to the County Council. The ultimate goal is the construction of one or more non-potable water reuse demonstration projects that will be permitted, owned and operated by KCDNR. The satellite projects would provide reclaimed water for appropriate, beneficial, and cost effective purposes. King County Department of Natural Resources (KCDNR) solicited project nominations from potential reclaimed water users in King County to evaluate the region's need and ability to support water reclamation demonstration plant(s). The request for project nomination (RFN) was the first of a two-phase approach to assist in identifying reclaimed water projects. During the evaluation of the eleven RFNs that were received, it became apparent that the Auburn/Kent Valley area, which was not part of the RFN responses, could represent a high potential for a reclaimed water demonstration project. Specifically, it was estimated that both the presence of the Auburn/Kent Interceptor and a number of potential users (e.g. golf courses, parks, and farmlands) within the Green River valley were supporting this hypothesis. Therefore, KCDNR added the evaluation of the Auburn/Kent Valley Reuse project as part of the reclaimed water assistance program evaluation. This technical memorandum summarizes information on the Auburn/Kent Valley Reuse Project, which is developed and will be subsequently ranked at a level consistent with that used for the evaluation of other water reuse projects that were submitted during the RFN process.

As with the other water reuse projects evaluated, the primary assumptions for any water reuse project are based upon the following parameters:

- The satellite treatment plant would be permitted, owned and operated by KCDNR
- Solids handling facilities are not included, therefore, there must be a sufficient volume of wastewater at the connection point during the summer season to convey solids to one of the regional plants

- Applications considered for this initial reclaimed water work program are limited to direct non-potable applications, i.e. irrigation and industrial uses

This project is evaluated in this Technical Memorandum, ranked in a subsequent process and will be included in the summary report and work program along with sufficient information concerning the project feasibility to allow decision-makers to fully evaluate all the projects that were considered.

Auburn/Kent Valley Reuse Project

Table 1 is a brief summary of the Auburn/Kent Valley Reuse project. Agricultural users were identified based on KCDNR's Farmland Preservation Properties (FPP) information in the Lower Green River agricultural production district. Other users, such as golf courses, nurseries and parks, were identified based upon field investigation and area maps. All the users are located along the Green River, across State Route (SR) 167 and SR516. The information presented in the table and text is based solely on information readily available, unless noted otherwise. Water consumption volumes were derived based on data for similar facilities, and on estimated irrigated acreage combined with agronomic rates cited in the State of Washington Irrigation Guide. The location of the various users is presented in Figure 1. All of the potential users that are currently irrigating appear to irrigate their sites by using either surface water directly from the Green River or Mill Creek, or by using groundwater. The water right status of each water source is unknown. No discussions have been held with any of the potential user; therefore, no further description of the potential users is available.

Cost Evaluation

The Auburn/Kent Valley project underwent the same evaluation process that was established to rank the RFN projects and determine which ones should be moved forward to a feasibility analysis stage. Results of the other water reuse project evaluations are presented in the July 2000 KCDNR *Reclaimed Water Program Demonstration Phase: Identification of Potential Satellite Projects for Direct Non-Potable Uses.*

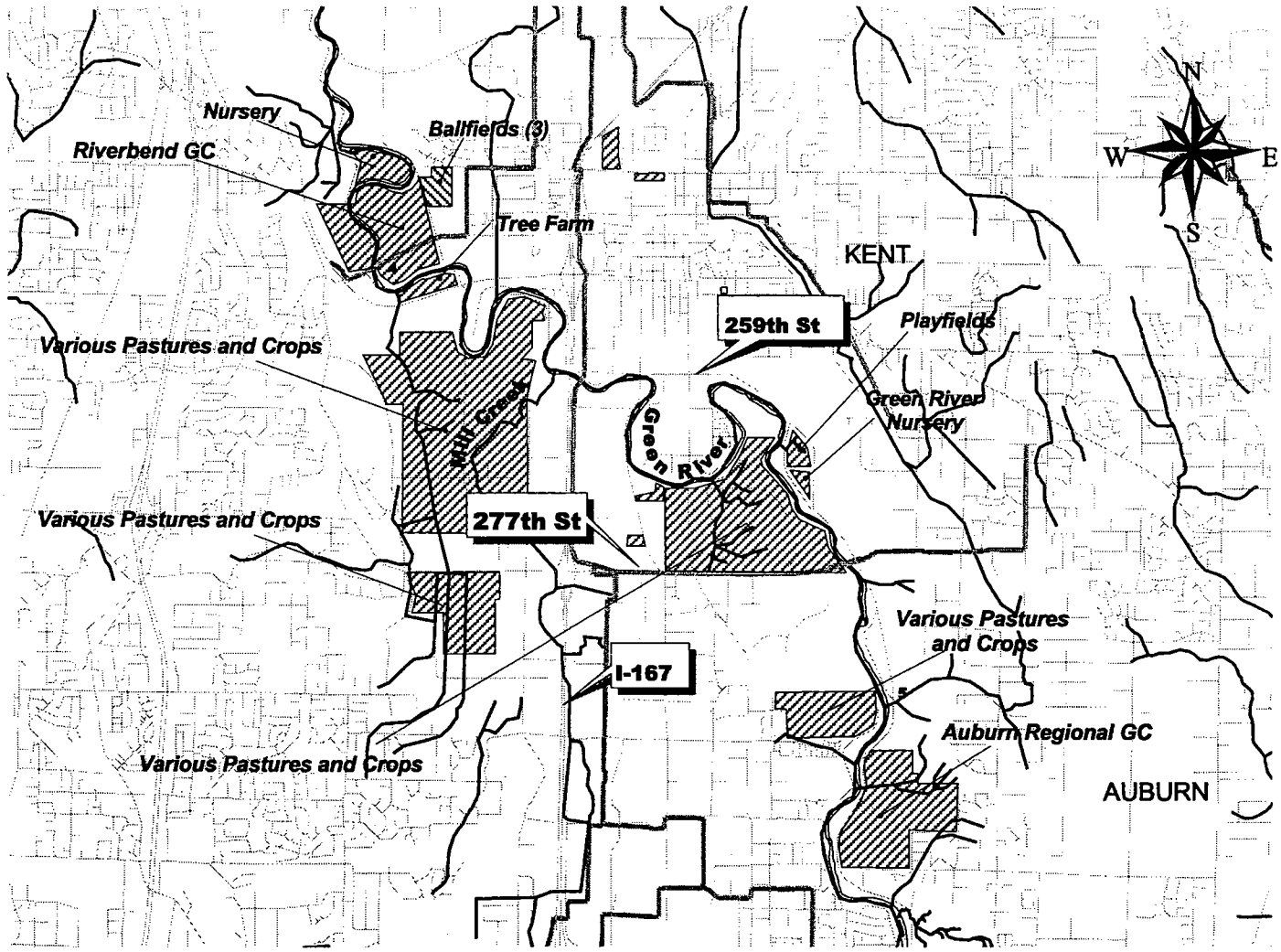
To support the overall evaluation process, the project's levelized cost is computed and compared with those of the RFN projects. Although it is focusing on determining the best means of providing the necessary treatment and conveyance of reclaimed water to potential users, this evaluation process should be considered preliminary and will be refined if the project is included in the subsequent feasibility phase.

Design Criteria

To develop comparable alternative costs, a number of assumptions were made regarding potential design criteria. Although these criteria are expected to be further refined in the feasibility analysis stage, preliminary criteria include operating parameters, treatment, and distribution/storage.

Figure 1

Reclaimed Water Project Evaluation: Auburn/Kent Valley Potential Users



Streets

KC Sewers

Potential Reclaimed Water User Area

TABLE 1
Summary of Auburn/Kent Valley Reuse project[1]

Potential Users	Acreage[2]	Estimated Irrigated Acreage[4,5,6]	Current Water Source (to be confirmed)[7]	Primary Reclaimed Water Use
West of State Route(SR)167				
Pastures and crops along the West Valley Hwy, south of SR516	560	504.0[3]	Green River, Mill Creek and/or ground water	Agricultural Irrigation
Pastures and crops south of S 277th St	112[3]	100.8	Green River, Mill Creek and/or ground water	Agricultural Irrigation
Tree Farm North of SR516	16	9.6	Green River and/or ground water	Irrigation
Riverbend Golf Course	162	145.8	Green River and ground water	Seasonal Irrigation
Russel Road Park	22	20.9	Unknown	Seasonal Irrigation of playfields
Nursery along Frager Rd	28	16.8	Green River and ground water	Irrigation
East of SR167				
Pastures and crops bordered by the Green River to the East and S 277th St to the South	295[3]	265.5	Green River and ground water	Agricultural Irrigation
North Green River Park	11	10.5	Unknown	Seasonal Irrigation of playfields
Green River Nursery	5	3.0	Green River and ground water	Seasonal Irrigation
Pastures and crops between I St and the Green River	84	75.6	Green River and ground water	Agricultural Irrigation
Auburn Regional Golf Course	185	166.5	Green River and ground water	Seasonal Irrigation

NOTES:
[1] – See Figure 1 for specific project location.
[2] – Acreage estimated from field inspection and cartography, unless otherwise noted.
[3] – Acreage estimated from KCDNR's Lower Green River Agricultural Production District aerial map (04/18/00).
[4] – Assumes 90% of estimated pastures, crops and golf courses acreage is irrigated.
[5] – Assumes 60% of estimated nursery acreage is irrigated.
[6] – Assumes 95% of estimated playfields (parks) acreage is irrigated.
[7] –The City of Kent Public Works (Engineering) department provided information that farmland and golf courses along the Green River do not take City water to irrigate their sites. It appears that all irrigation water comes from surface water, either directly from the Green River, Mill Creek, or through wells. The water rights status of each water source is unknown at this point.

Operating Parameters

The most important operating parameter, aside from treatment and distribution/storage, is the operating schedule of the reclamation facilities. Facilities could be operated either seasonally or year-round depending on water demand. However, the potential users identified for the Auburn/Kent Valley project include mostly summer irrigation uses (e.g., golf courses, parks, and agricultural land) and nurseries that have marginal demand. Therefore, it was assumed that the facilities would operate only 5 months per year (May-September).

Standard reclaimed water facilities draw wastewater from the sewer system for full-process liquid stream treatment, including biological secondary treatment and tertiary treatment using filtration to prepare Class A reclaimed water suitable for reuse. In this evaluation, wastewater solids derived from satellite secondary and tertiary treatment processes would be reintroduced into the sewer system for conveyance and treatment at KCDNR's South Treatment Plant at Renton. The reclaimed water distribution system includes pump stations and pipelines for the conveyance and distribution of reclaimed water to potential users. For this evaluation, the opportunities and benefits for coincident construction with other utility projects have not been included.

Treatment

The treatment criteria for the reclaimed water facilities are determined by the specific applications of reclaimed water. The reclaimed water would be largely used for unrestricted access, such as irrigation purposes at various parks and golf courses. This use falls under the most stringent reuse criteria set by the Washington State Department of Health (DOH) that requires reclaimed water to be oxidized, filtered, and disinfected (Class A reclaimed water).

It must be noted that this investigation does not examine the benefits or drawbacks of numerous alternative treatment systems able to produce effluent with the desired quality. That analysis will be conducted as the preferred project(s) is/are more fully developed (e.g. predesign phase). Continuous backwashing filters and chlorine disinfection were selected for sizing all tertiary treatment facilities. These unit processes are selected since they are widely used for this application and provide high levels of confidence in their ability to perform well and meet all water quality requirements. This process treatment train, common to all locations investigated, includes filter feed pumping where needed, chemical filter aid addition (alum and polymer dosing), filtration, chlorine dosing, storage, and reclaimed water pumping. Table 2 lists the criteria used to size each unit process.

Filters. Continuously-backwashing filters were sized for a continuous 24-hour a day operation at a peak day loading rate of 3.5 gpm/sq ft of filter area. Based on these criteria, a filter feed pumping station was sized for each alternative based on total peak day demand flow requirements. Each filter feed pumping station would consist of at least two vertical turbine pumps (one as an additional pump for backup service and to provide service rotation) to lift treated wastewater to the proper elevation for overcoming the head losses through the filter. To continue with the conservative estimation of treatment requirements, both alum and polymer feed systems were sized for maximum perceived dosages to assist in filtering of solids. Additionally, an alarm system would be installed to warn of failure of electrical power, filter feed pumps, filters, or alum or polymer feed pumps.

TABLE 2
Reclamation Facility Tertiary Treatment Sizing Criteria

Factor	Units	Value
Filtration		
Unit filtration rate	gpm/sq ft	3.5
Unit air requirement (@ 20-25 psig)	scfm/sq ft	0.05
Alum dose (min / max)	mg/l	100 / 150
Polymer dose	mg/l	5
Backwash reject rate	gpm/sf	0.16
Chlorine disinfection and residual		
Applied dose concentration	mg/l	5
Residual concentration, minimum	mg/l	0.5

Chlorine Disinfection. As required by DOH, chlorine would be injected upstream of the storage tank to provide disinfectant residual in the distribution system. A reclaimed water storage tank would provide contact time and mixing energy for adequate dispersion of chlorine. Chlorine is added in a similar method at the existing KCDNR South Treatment Plant's Reclaimed Water Facility. To meet DOH criteria, a standby chlorine feed system, alarm system, and manifolded chlorine piping, as well as other features, would be installed.

Distribution/Storage

Sizing of each treatment and conveyance unit is normally defined by peak day demand (PDD) and peak hour demand (PHD), respectively. However, it was assumed that golf course users would be able to utilize existing ornamental ponds for storage of reclaimed water. Therefore, the conveyance systems to golf courses were sized for PDD rather than for PHD. When multiple users were present along a distribution line, a combination of PHD and PDD was used for conveying system sizing. Stated another way, golf courses would use their existing ornamental ponds to provide peak hour flows, whereas non-golf course irrigation users would obtain their peak hour flows from the reclaimed water storage and distribution piping systems.

Two options exist for conveying reclaimed water to the usage areas: elevated storage plus gravity conveyance or low head storage plus pumped conveyance. The elevated storage plus gravity conveyance alternative would consist of a pumping station at the treatment plant delivering the reclaimed water at a rate matching reclaimed water filter production to an elevated storage tank. This tank would be situated at an elevation with enough head to provide adequate irrigation pressures by gravity. Irrigation pressures were based on providing a pressure of 20 psi to the last user on the distribution system. By inspection, economics favor the low head storage plus pumped conveyance mode of distribution. For this preliminary evaluation, the low head storage alternative evaluated assumes that the storage tank would be located at the satellite plant. However, distribution costs could be reduced if storage is located onsite at a large user location and long distribution lines sized for PDD instead of PHD. As stated earlier, it was assumed that golf course users would not need additional onsite storage because ponds with sufficient storage capacity already exist.

For golf courses, parks, and playfields, the reclaimed water distribution pumping station would operate primarily during the time of irrigation demand (10 hours per day) to supply sufficient pressure for irrigation distribution. However, it is assumed that crops could be irrigated up to 24 hours a day. The storage tank, which would be sized to offset the differences in peak irrigation demand and reclaimed water production rates, would serve as the wet well for vertical turbine pumps installed above grade. Variable frequency drives would be required for these pumps to reduce the transient effects on the pumps, valves, and piping, and to more precisely meet actual reclaimed water demand. To economically minimize power consumption, conveyance piping was sized so that the total dynamic head would approach 300 feet per reclaimed water pumping station.

Potential Reclaimed Water Demands

Table 1 listed potential users identified in the Auburn/Kent Valley. Since none of those users were part of the RFN process and that water demand was not available for this evaluation, irrigation water demand had to be estimated. The operating conditions used to size and evaluate the facility were therefore estimated through agronomic rates from the State of Washington Irrigation Guide and assumptions outlined earlier in this memorandum. Specifically, golf course irrigation demand was based on turf irrigation rates in Washington State, while average consumption rates for nurseries and agricultural land were based on average agronomic rates applied to the estimated irrigated acreage. The average agronomic rate of irrigation for crops was based on rates for potato, field corn, strawberries, raspberries, and turf crops as given in the State of Washington Irrigation Guide for the Auburn/Kent area. Similarly, peak day demands (PDD) were calculated using a peaking factor from the agronomic data set. Those assumptions will be revised if this evaluation is further refined. In addition, it must be noted that the majority of the potential users identified in Table 1 represent irrigable land that do not necessarily irrigate at the present; they have been identified as being potential users. Additional investigation will need to be conducted to determine if it makes sense to convert the dry land farming to a more water intensive crop. Specific water use information will need to be collected in the next phases of the evaluation, if the Auburn/Kent Valley project is part of the top-ranking projects.

Peak hour demands (PHD) were used to determine the appropriate pipeline sizing and storage needs, with the exception of golf courses which are considered to have onsite storage. A typical peaking factor of 2.4 PHD/PDD was used for parks (e.g. playfields) and golf courses, representing 10 hours of irrigation within a 24-hour day. It was assumed that agricultural land would be irrigated 24 hours per day, representing a peaking factor of 1.00 PHD/PDD. Table 3 presents a listing of the estimated water demand for each identified user or application site.

TABLE 3.
Reclaimed Water Flow Demand in the Auburn/Kent Valley

Potential Satellite Plant Location	Potential Users	Average day[a,b],MGD	PDD[c], MGD	PHD for pipe sizing[d], MGD (gpm)
Green River and Auburn Interceptor				
West of SR167	Pastures and crops along the West Valley Hwy, south of SR516	1.66	2.68	2.68 (1861)
	Pastures and crops south of S 277th St	0.33	0.54	0.54 (375)
	Tree Farm North of SR516	0.03	0.05	0.05 (35)
	Riverbend Golf Course	0.63	0.97	0.97[e] (674)
	Russel Road Park	0.09	0.14	0.33[f] (229)
	Nursery along Frager Rd	0.06	0.09	0.09 (63)
East of SR167	Pastures and crops bordered by the Green River to the East and S 277th St to the South	0.88	1.41	1.41 (979)
	North Green River Park	0.04	0.07	0.17[f] (118)
	Green River Nursery	0.01	0.02	0.02 (14)
	Pastures and crops between I St and the Green River	0.25	0.40	0.40 (278)
	Auburn Regional Golf Course	0.72	1.10	1.10[e] (764)
	TOTAL	4.70	7.5	7.71 (5390)

[a] During irrigation period (May-September)

[b] Average day demand estimated from agronomic rates in Washington State. For crops and pastures, an average irrigation rate of 0.33 MGD/100 acres is used, based on potato, corn field, berries, and turf crops irrigation data.

[c] Peak day demands (PDD) of crops and pastures are based on applying a 1.612 peaking factor to the average value of average day demand. PDD of golf course users and parks are based on applying a 1.540 peaking factor (from turf irrigation data).

[d] Assumes a peaking factor of 1.00 PHD/PDD based on assumption of 24 hours irrigation per day for agricultural irrigation.

[e] Assuming that existing ornamental ponds would be used for storage at golf course locations, peak day demand is used for pipe sizing.

[f] Assuming a peaking factor of 2.4 PHD/PDD based on 10 hours irrigation per day.

Development of Auburn/Kent Valley Reuse Projects

Two water reuse options were evaluated. First, a new satellite plant could be constructed in the vicinity of the Auburn Interceptor and the identified water users. However, the implementation of this option is limited by the maximum available flows in the sewer system, as discussed below. This requires a phased construction project as available sewage

flow increases. The second option is to take advantage of KCDNR's South Treatment Plant's relative proximity to the Auburn/Kent Valley for the production of reclaimed water. This option offers the advantage of eliminating the need of secondary treatment in the reuse project capital investment, but adds substantial distribution costs. Both options are discussed in more detail below.

Option 1: New Reclaimed Water Satellite Plant

Location. A new reclaimed water satellite plant located along 259th St, near SR167 would provide direct access to the Auburn Interceptor, which runs along SR167. From KCDNR's information, average dry weather flow at this location is about 9.3 MGD. For this option, it is necessary to evaluate the maximum amount of water available in the Interceptor for reclaimed water production.

Maximum Available Wastewater Flows for Reclamation. A comparison between user demands and available wastewater flows in the sewer system gives a first indication on facilities sizing. The two following criteria were used to determine the maximum available flow in the existing sewer system, suitable for reclaimed water production:

- Average dry weather flow available in the sewers, and
- A minimum carrying velocity of 2.5 feet per second (fps) for solids conveyance within the sewer system.

Irrigation occurs during dry weather, usually between May and September. Wastewater would be diverted from the sewer system to the reclamation water treatment plant in quantities to meet the user demands. This diversion could cause solids deposition within the sewer system downstream if a minimum velocity is not maintained in the conveying pipe. It is generally accepted that the minimum velocity should be at least 2.5 fps to ensure solids conveyance. The minimal flow requirement in the sewer line downstream of the diversion point is determined from this minimal velocity and the sewer line geometry. Since the filter system operates 24 hours per day, the maximum amount of wastewater available for reuse is estimated from the minimal flow needed for solids conveyance and the average dry weather flow available in the sewer line.

Maximum available flow was determined at the projected sewage diversion point and is presented in Table 4. Diameter and slope information was obtained through KCDNR's sewer database[1]. Flow information was obtained directly through discussions with King County's Waste Treatment Division (WTD) department. Flow was calculated using Manning's equation applied to partially full pipes, with a roughness coefficient of 0.013.

The data in Table 4 indicates that at least 4.4 MGD of sewage must remain in the downstream portion of the pipe after the diversion point to ensure that the solids are being conveyed. Therefore, based on current dry weather flows in the Interceptor, the current maximum available flow for reclaimed water purposes would be 4.9 MGD.

[1] King County GIS Technical Resource Center CD-Rom#7 Standard database shapefiles, October 1997.

TABLE 4.
Maximum Currently Available Flow for Reclamation Water[a]

Satellite Plant	Minimum Downstr. Velocity[b] (fps)	Slope (vft/hft)	Line Diameter (inch)	Minimum Flow Needed[b] (MGD)	Avg. Dry Weather Flow (MGD)[c]	Maximum Amount Available (MGD)
Auburn/Kent Valley	2.5	0.001	72	4.4	9.3	4.9

[a]Unless otherwise noted, pipe diameter, slope and flows : King County GIS Technical Resource Center CD-Rom#7 Standard database shapefiles, October 1997.

[b]As determined for solids conveyance.

[c]Flow information from communication with Bob Swarner, King County, WTD department, March 2000.

Design Flow Criteria. Upon development of the reclaimed water flow demand, the design flow criteria for the reclaimed water treatment, storage, and transmission piping facilities was estimated. General economic and engineering practice suggests that oversized buried conveyance piping be installed in the initial phase of construction to account for future flow demand. The available flow data shown in Table 4 indicates that the maximum currently available sewage flow available for reuse in the Auburn Interceptor is 4.9 MGD. Since the estimated reclaimed water demand exceeds the available sewage for reuse, the Auburn/Kent Valley project is developed in two phases: Phase I includes facilities sizing for a reclaimed water production of 4.7 MGD, to serve those users, predominantly farmland, located nearest to the satellite facility. Under this scenario, the storage facilities and distribution system are sized to accommodate future expansion to provide the total reclaimed water demand presented in Table 4. Phase II would include the addition of modules to the treatment process, as well as pumping capacity to the distribution system, to include all identified users along the Green River, from the Auburn Regional Golf Course (south) to the Riverbend Golf Course (north).

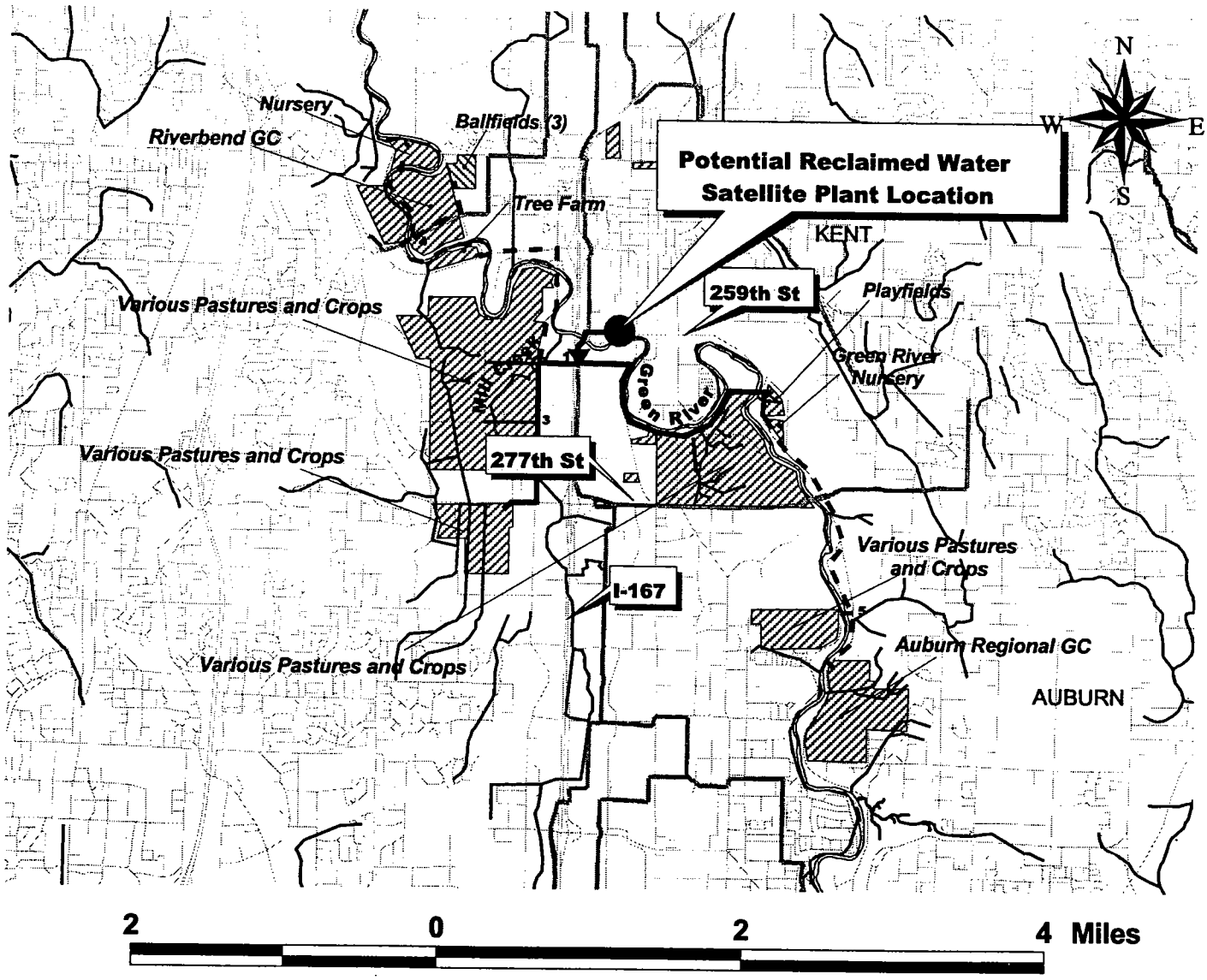
This technical memorandum presents Phase I facilities sizing. However, in the event that the construction of the reclaimed water facilities are reported and that the base flow generated in the Auburn interceptor at the time of construction could accommodate the total reclaimed water demand presented in Table 4, costs for the total project have also been evaluated. Additional investigation is needed to confirm all current and future flow demands. Figure 2 illustrates both the Phase I and the Complete project option.

Option 2: Production of Reclaimed Water from South Treatment Plant at Renton

The data presented in Tables 3 and 4 show that current available flows in the Auburn Interceptor for reclamation production limits the size of a potential satellite plant for the identified water demands. The amount of reclaimed water demand in the Auburn/Kent Valley justifies evaluating the option of providing reclaimed water from KCDNR's South Treatment Plant. The South Treatment Plant is a regional sewer facility with very large flows, complete secondary treatment, and an existing 1 mgd reclamation treatment facility. In this option, only additional tertiary treatment capacity and storage facilities are needed, in addition to distribution facilities, to convey the reclaimed water from the South Treatment Plant to all potential users identified (as listed in Table 3). This option is not

Figure 2

Reclaimed Water Project Evaluation: Auburn/Kent Valley



Streets

KC Sewers

Proposed Reclaimed Water Pipe Route - Phase I

Proposed Reclaimed Water Pipe Route - Complete project

Potential Reclaimed Water User Area

August 2000

limited by the available flows in the sewer system; therefore, it has been sized at 7.5 mgd to meet all identified reclaimed water needs. Figure 3 illustrates the reclaimed water production and conveyance facilities for the South Treatment Plant option.

A summary of reclamation facilities design flow criteria for both options is presented in Table 5. This table shows the basic flow design data to be used for this investigation for reclamation treatment, storage, pumping, and transmission.

TABLE 5.
Summary of Reclamation Facilities Design Criteria for the Auburn/Kent Reuse project evaluation

Alternative	Design Flow for Secondary and Tertiary Treatment (MGD)	Total Reclaimed Water Storage[c] (MG)
New Satellite Plant – Phase I[a]	4.7	2.7
New Satellite Plant – Total Project Expansion[b]	7.5	6.1
Reclaimed Water via South Treatment Plant	7.5[d]	6.1

[a] Includes oversized distribution piping and storage for expansion to accommodate the total reclaimed water demand as sewage base flow increases.

[b] Phases 1 and 2 combined, assuming that sewage base flow is sufficient to accommodate the current reclaimed water demand.

[c] Assuming that existing ornamental ponds would be used for reclaimed water storage at golf course locations. Storage is provided for non golf course users only at the satellite plant location.

[d] Tertiary treatment only

Estimated Costs

The method followed for cost estimation has been previously described in KCDNR's *Reclaimed Water Program Demonstration Phase: Identification of Potential Satellite Projects for Direct Non-Potable Uses, Summary and Appendices* (July 2000).

Cost analyses were performed for each alternative following the method previously established. Tables 6 and 7 lists the project capital costs for each alternative based on distribution, secondary treatment, and tertiary treatment facilities. Operations and maintenance (O&M) costs and the unit cost of producing reclaimed water (in dollars per hundred cubic feet, $/ccf) are also presented in Tables 6, 7 and 8. The estimated distribution length and seasonal operation (5 months per year) of the facilities have a large impact on these unit costs. The cost estimating spreadsheets are presented in Attachment 1.

Figure 3

Reclaimed Water Project Evaluation: Auburn/Kent Valley

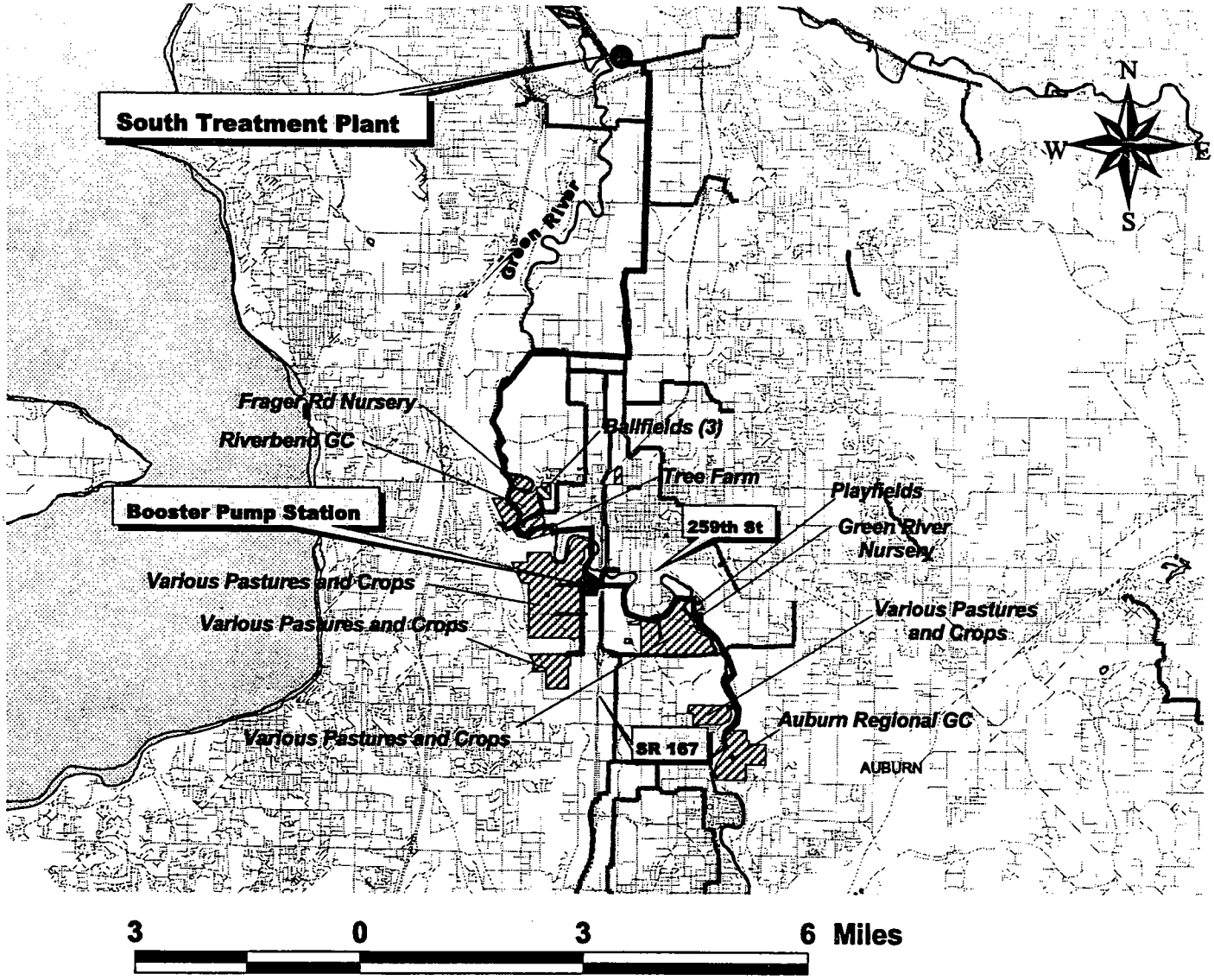


TABLE 6
Auburn/Kent Reuse Facility Project Costs – New Satellite Treatment Plant: Phase I

Item	Capital Cost (year 2000)[b]	O&M Cost[c]	Unit Cost ($/ccf)[d]
Distribution System[a]	$13,100,000	$80,000	
Secondary Treatment	$30,900,000	$270,000	
Tertiary Treatment	$8,100,000	$190,000	
Total	**$52,100,000**	**$540,000**	**$4.58**

[a] Includes oversized distribution system and storage to accommodate total demand in future. Without oversizing, the total project capital costs would be $50,600,000, O&M would be $540,000, and levelized unit cost would be $4.49/ccf.

[b] Includes Contingency (25%), Sales tax (8.6%), Engr/Admin/Legal (35%).

[c] Includes pipe and pump maintenance costs with power based on 75% efficiency, storage tank maintenance costs, and chemical costs

[d] Levelized unit cost is obtained from the ratio of the total of the equivalent annual costs over a 35-year cycle divided by the total ccf of reclaimed water produced over the cycle. The equivalent annual cost includes O&M costs, salvage value, and capital recovery payments, annualized with a 3 % discount rate factor and 6.25 % interest rate. The salvage value is estimated on static facilities (80% of distribution and 50% of treatment equipment), using straight line depreciation over 75 years.

TABLE 7
Auburn/Kent Reuse Facility Project Costs – New Satellite Treatment Plant: Total Project Expansion[a]

Item	Capital Cost (year 2000)[b]	O&M Cost[c]	Unit Cost ($/ccf)[d]
Distribution System	$16,900,000	$110,000	
Secondary Treatment	$42,200,000	$410,000	
Tertiary Treatment	$11,000,000	$280,000	
Total	**$70,100,000**	**$800,000**	**$3.92**

[a] Assuming that sewage base flow is sufficient to accommodate the current reclaimed water demand.

[b] Includes Contingency (25%), Sales tax (8.6%), Engr/Admin/Legal (35%).

[c] Includes pipe and pump maintenance costs with power based on 75% efficiency, storage tank maintenance costs, and chemical costs

[d] Levelized unit cost is obtained from the ratio of the total of the equivalent annual costs over a 35-year cycle divided by the total ccf of reclaimed water produced over the cycle. The equivalent annual cost includes O&M costs, salvage value, and capital recovery payments, annualized with a 3 % discount rate factor and 6.25 % interest rate. The salvage value is estimated on static facilities (80% of distribution and 50% of treatment equipment), using straight line depreciation over 75 years.

TABLE 8
Auburn/Kent Reuse Facility Project Costs – Reclaimed Water via South Treatment Plant

Item	Capital Cost (year 2000)[a]	O&M Cost[b]	Unit Cost ($/ccf)[c]
Distribution System	$26,700,000[d]	$180,000	
Secondary Treatment	--	--	
Tertiary Treatment[e]	$11,600,000	$300,000	
Total	**$38,300,000**	**$480,000**	**$2.32**

[a] Includes Contingency (25%), Sales tax (8.6%), Engr/Admin/Legal (35%).

[b] Includes pipe and pump maintenance costs with power based on 75% efficiency, storage tank maintenance costs, and chemical costs

[c] Levelized unit cost is obtained from the ratio of the total of the equivalent annual costs over a 35-year cycle divided by the total ccf of reclaimed water produced over the cycle. The equivalent annual cost includes O&M costs, salvage value, and capital recovery payments, annualized with a 3% discount rate factor and 6.25% interest rate. The salvage value is estimated on static facilities (80% of distribution and 50% of treatment equipment), using straight line depreciation over 75 years.

[d] Includes a booster pump station to distribute reclaimed water to users east of SR 167 (see Figure 3)

[e] Due to the size of the storage tank, costs include additional filter effluent/storage tank feed pumps.

Attachment 1: Cost Estimating Spreadsheets

TASK 4.20 - DISTRIBUTION SYSTEM COSTS - CONSTRUCTION COSTS

Includes pumps and pipeline from the the satellite plant to each user

1- Complete project: ***Assuming enough sewage available***

Project	Pipe Routing	Plant capacity MGD	Piping length L (ft)	Pump Station costs: Flow for Pipe sizing[b] MGD	D inches	v ft/sec	Manning's n	Manning's friction loss Hf (ft)	static head ft	Delivered P requ'd ft	TDH[c] ft	Base pump sta. constr, $	Mob/ Demob, 0%, $	Contin-gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Total pump sta. constr cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $
Auburn Valley Project[a]	Total flow, to first split (1)	7.5	2,200	7.80	18	6.85	0.010	**17**	20	20	266	1,350,000	0	337,500	0	145,125	1,832,625	641,419	2,474,044
	From (1) to (2)		1,400	4.70	14	6.82	0.010	15											
	West Pastures and Crops pipes		1,900	1.34	8	5.95	0.010	**33**											
	West Pastures and Crops pipes		1,900	1.34	8	5.95	0.010	**33**											
	From (2) to (3)		2,100	1.88	10	5.35	0.010	**22**			147								
	From (3) to Southwest pastures and crops		4,000	0.54	6	4.26	0.010	53											
	From (2) to Tree Farm		7,000	1.48	10	4.21	0.010	45			212								
	From Tree Farm to (4) (Riverbend GC)		3,840	1.41	10	4.01	0.010	**23**											
	From (4) to Frager Rd Nursery		3,050	0.12	4	2.13	0.010	**17**											
	From (4) to BallFields		2,940	0.33	4	5.86	0.010	126											
	From (1) to East pastures&crops		6,300	3.10	14	4.50	0.010	**30**											
	Pastures and crops' pipe		1,200	1.41	8	6.26	0.010	23											
	From East pastures and crops to Playfields		4,500	1.69	10	4.81	0.010	**38**											
	From Green River Playfields to Green River Nursery		1,200	1.52	10	4.32	0.010	**8**											
	From Green River Nursery to (5) (pastures and crops)		7,750	1.50	10	4.26	0.010	**52**											
	Pastures and crops' pipe		800	0.40	4	7.11	0.010	50											
	From (5) to Auburn GC		2,300	1.10	8	4.89	0.010	**27**											

a.The reclaimed water produced is distributed to multiple users; distribution line costs are calculated for various section and added to give total cost.

b. Distribution lines are sized to provide peak hour demand to non golf course users and peak day demand to golf course users. Non golf course users and parks peak day demand based on 18 hr per 24hr irrigation time. Golf courses and parks (e.g. playfields) peak day demand based on 10 hr per 24 hr irrigation time.

c. Includes Manning's friction losses in **bold**

2- Intermediate Project : ***Based on current available sewage flow (oversized for future)***

Project	Pipe Routing	Plant capacity MGD	Piping length L (ft)	Pump Station costs: Flow for Pipe sizing[b] MGD	D inches	v ft/sec	Manning's n	Manning's friction loss Hf (ft)	static head ft	Delivered P requ'd ft	TDH ft	Base pump sta. constr, $	Mob/ Demob, 0%, $	Contin-gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Total pump sta. constr cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $
Auburn Valley Project[a] *Oversized to accommodate other users as sewage flows increase*	Total flow, to first split (1)	4.7	2,200	7.80	18	6.85	0.010	**17**	20	20	147	1,100,000	0	275,000	0	118,250	1,493,250	522,638	2,015,888
	From (1) to (2)		1,400	4.70	14	6.82	0.010	15											
	West Pastures and Crops pipes		1,900	1.34	8	5.95	0.010	**33**			133								
	West Pastures and Crops pipes		1,900	1.34	8	5.95	0.010	**33**											
	From (2) to (3)		2,100	1.88	10	5.35	0.010	**22**											
	From (3) to Southwest pastures and crops		4,000	0.54	6	4.26	0.010	53											
	From (1) to East pastures&crops		6,300	3.10	14	4.50	0.010	30											
	Pastures and crops' pipe		1,200	1.41	8	6.26	0.010	23											
	From East pastures and crops to Playfields		4,500	1.69	10	4.81	0.010	38											
	From Green River Playfields to Green River Nursery		1,200	1.52	10	4.32	0.010	8											

a.The reclaimed water produced is distributed to multiple users; distribution line costs are calculated for various section and added to give total cost.

b. Distribution lines are sized to provide peak hour demand to non golf course users and peak day demand to golf course users. Non golf course users and parks peak day demand based on 18 hr per 24hr irrigation time. Golf courses and parks (e.g. playfields) peak day demand based on 10 hr per 24 hr irrigation time.

c. Includes Manning's friction losses in **bold**

Mob/Demob=	0.0%
Contingency =	25.0%
Sales tax =	8.6%
ELA =	35.0%
Contractor O&P=	0.0%

TASK 4.20 - DISTRIBUTION SYSTEM COSTS - CONSTRUCTION COSTS

Includes pumps and pipeline from the the satellite plant to each user

1- Complete project: ***Assuming enough sewage available***

		Pipeline construction costs									Storage construction costs[d]										
Project	Pipe Routing	pipeline unit cost, $/lf	base pipe constr cost, $	Mob/ Demob, 0%, $	Contin-gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Total pipeline constr cost,$	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Irrigation storage vol, MG	base storage tank constr cost, $	Mob/ Demob, 0%, $	Contin-gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Storage tank construction cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Total Project cost in 1995 $	After ENR Indexation[e,f] in $ 2000
Auburn Valley Project[a]	Total flow, to first split (1)	87	191,400	0	773,778	0	332,724	4,201,612	1,470,564	5,672,176	6.1	3,052,500	0	763,125	0	328,144	4,143,769	1,450,319	5,594,088	13,740,308	$ 16,941,000
	From (1) to (2)	71	99,400																		
	West Pastures and Crops pipes	52	98,800																		
	West Pastures and Crops pipes	52	98,800																		
	From (2) to (3)	57	119,700																		
	From (3) to Southwest pastures and crops	47	188,000																		
	From (2) to Tree Farm	57	399,000																		
	From Tree Farm to (4) (Riverbend GC)	57	218,880																		
	From (4) to Frager Rd Nursery	42	128,100																		
	From (4) to BallFields	42	123,480																		
	From (1) to East pastures&crops	71	447,300																		
	Pastures and crops' pipe	52	62,400																		
	From East pastures and crops to Playfields	57	256,500																		
	From Green River Playfields to Green River Nursery	57	68,400																		
	From Green River Nursery to (5) (pastures and crops)	57	441,750																		
	Pastures and crops' pipe	42	33,600																		
	From (5) to Auburn GC	52	119,600																		

a.The reclaimed water produced is distributed to multiple users; distribution line costs are calculated for various section and added to give total cost.

b. Distribution lines are sized to provide peak hour demand to non golf course users and peak day demand to golf course users. Non golf course users and parks peak day demand based on 18 hr per 24hr irrigation time. Golf courses and parks (e.g. playfields) peak day demand based on 10 hr per 24 hr irrigation time.

c. Includes Manning's friction losses in **bold**

d. It is assumed that storage is not necessary at golf course locations where existing ponds can be used for reclamation water storage.

e. ENR Sept-1995, Seattle area, construction =5800

f. ENR Feb-2000, Seattle area, construction = 7151

2- Intermediate Project : ***Based on current available sewage flow (oversized for future)***

		Pipeline construction costs									Storage construction costsd										
Project	Pipe Routing	pipeline unit cost, $/lf	base pipe constr cost, $	Mob/ Demob, 0%, $	Contin-gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Total pipeline constr cost,$	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Irrigation storage vol, Mg[c]	base storage tank constr cost, $	Mob/ Demob, 0%, $	Contin-gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Storage tank construction cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Total Project cost in 1995 $	After ENR Indexation[e,f] in $ 2000
Auburn Valley Project[a]	Total flow, to first split (1)	87	191,400	0	407,675	0	175,300	2,213,675	774,786	2,988,462	6.1	3,052,500	0	763,125	0	328,144	4,143,769	1,450,319	5,594,088	10,598,437	$ 13,068,000
Oversized to accommodate other users as sewage flows increase	From (1) to (2)	71	99,400																		
	West Pastures and Crops pipes	52	98,800																		
	West Pastures and Crops pipes	52	98,800																		
	From (2) to (3)	57	119,700																		
	From (3) to Southwest pastures and crops	47	188,000																		
	From (1) to East pastures&crops	71	447,300																		
	Pastures and crops' pipe	52	62,400																		
	From East pastures and crops to Playfields	57	256,500																		
	From Green River Playfields to Green River Nursery	57	68,400																		

a.The reclaimed water produced is distributed to multiple users; distribution line costs are calculated for various section and added to give total cost.

b. Distribution lines are sized to provide peak hour demand to non golf course users and peak day demand to golf course users. Non golf course users and parks peak day demand based on 18 hr per 24hr irrigation time. Golf courses and parks (e.g. playfields) peak day demand based on 10 hr per 24 hr irrigation time.

c. Includes Manning's friction losses in **bold**

d. It is assumed that storage is not necessary at golf course locations where existing ponds can be used for reclamation water storage.

e. ENR Sept-1995, Seattle area, construction =5800

f. ENR Feb-2000, Seattle area, construction = 7151

TASK 4.20 - DISTRIBUTION SYSTEM COSTS - ANNUAL O&M COSTS

1- Complete project: ***Assuming enough sewage available***

			ANNUAL PUMPING STATION O&M COSTS[a]														ANNUAL PIPELINE O&M[a]		ANNUAL STORAGE O&M[b]			
Project	Average volume MGD	Total Piping L (ft)	Total pump sta. construction costs, $	annual pump maintenance costs, 1995 US$	TDH ft	overall pump efficiency, %	annual power req's @ peak flow, kw-hr	annual pump usage, %[a]	actual annual power req's, kw-hr	cost per kw-hr, $	annual pump power cost, 1995 US$	peak flow annual labor req's, hrs	annual usage %[a]	actual annual labor, hrs	labor cost $/hr	annual pump O&M labor cost, $	Total annual pump O&M costs, $	Total pipeline construction costs, $	annual pipe maintenance costs, 1995 US$	Storage tank Construction costs, $	annual storage tank maint. costs, $	Total annual distribution system O&M costs, $/year	After ENR Cost Indexation [c,d] $2,000
Auburn Valley Project	4.7	54,380	1,832,625	9,163	212	75%	1,523,769	42%	635,412	0.034	21,604	800	42%	334	45	15,012	45,779	4,201,612	21,008	4,143,769	20,719	87,506	$ 108,000

a. Assumes irrigation operations 5 months/year
b. It is assumed that storage is not necessary at golf course locations where existing ponds can be used for reclamation water storage.
c. ENR Sept-1995, Seattle area, construction =5800
d. Costs are additive for Newcastle GC and Mutual Materials

2- Phase I option : ***Based on current available sewage flow***
(oversized for future)

			ANNUAL PUMPING STATION O&M COSTS[a]														ANNUAL PIPELINE O&M[a]		ANNUAL STORAGE O&M[b]			
Project	Average volume MGD	Total Piping L (ft)	Total pump sta. construction costs, $	annual pump maintenance costs, 1995 US$	TDH ft	overall pump efficiency, %	annual power req's @ peak flow, kw-hr	annual pump usage, %[a]	actual annual power req's, kw-hr	cost per kw-hr, $	annual pump power cost, 1995 US$	peak flow annual labor req's, hrs	annual usage %[a]	actual annual labor, hrs	labor cost $/hr	annual pump O&M labor cost, $	Total annual pump O&M costs, $	Total pipeline construction costs, $	annual pipe maintenance costs, 1995 US$	Storage tank Construction costs, $	annual storage tank maint. costs, $	Total annual distribution system O&M costs, $/year	After ENR Cost Indexation [c,d] $2,000
Auburn Valley Project	2.93	26,700	1,493,250	7,466	147	75%	659,021	42%	274,812	0.034	9,344	700	42%	292	45	13,136	29,945	2,213,675	11,068	4,143,769	20,719	61,733	$ 77,000

a. Assumes irrigation operations 5 months/year
b. It is assumed that storage is not necessary at golf course locations where existing ponds can be used for reclamation water storage.
c. ENR Sept-1995, Seattle area, construction =5800
d. ENR Feb-2000, Seattle area, construction = 7151

TASK 4.20 - TERTIARY TREATMENT CAPITAL COSTS
CLASS A RECLAIMED WATER TREATMENT SYSTEM

1- Complete project: ***Assuming enough sewage available***

		FILTER CHEMICAL FEED SYSTEM			FILTER FEED PUMPS										FILTERS									
Project	Plant capacity MGD	Alum/polymer feed syst. constr cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Friction head loss, ft	static head ft	TDH ft	Base pump sta. constr, $	Mob/ Demob, 0%, $	Contin- gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Total feed pumps constr cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Filter loading rate gpm/sf	Filter surface area, sf	Base filter constr. cost, $	Mob/ Demob, 0%, $	Contin- gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Total filter constr cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $
Auburn Valley Project	7.5	750,000	262,500	1,012,500	10	20	30	285,000	0	71,250	0	30,638	386,888	135,411	522,298	3.5	1488	3,560,000	0	890,000	0	382,700	4,832,700	1,691,445	6,524,145

2- Phase I option : ***Based on current available sewage flow (oversized for future)***

		FILTER CHEMICAL FEED SYSTEM			FILTER FEED PUMPS										FILTERS									
Project	Plant capacity MGD	Alum/polymer feed syst. constr cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Friction head loss, ft	static head ft	TDH ft	Base pump sta. constr, $	Mob/ Demob, 0%, $	Contin- gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Total feed pumps constr cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Filter loading rate gpm/sf	Filter surface area, sf	Base filter constr. cost, $	Mob/ Demob, 0%, $	Contin- gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Total filter constr cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $
Auburn Valley Project	4.7	700,000	245,000	945,000	10	20	30	213,000	0	53,250	0	22,898	289,148	101,202	390,349	3.5	933	2,435,000	0	608,750	0	261,763	3,305,513	1,156,929	4,462,442

TASK 4.20 - TERTIARY TRE
CLASS A RECLAIMED WAT

1- Complete project:

	CHLORINATION SYSTEM CONSTRUCTION COST											CHLORINE TANK CONSTRUCTION COSTS											
Project	Chlorine dosage, mg/l	Chlorine peak use, lbs/day	Cl system base constr cost, $	Mob/ Demob, 0%, $	Contin- gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Cl system cost w/o UFC upgrade	Cl system cost w/UFC upgrade, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Cl tank det. time, min	Cl tank vol, cf	Cl tank base constr cost, $	Mob/ Demob, 0%, $	Contin- gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Total Cl tank cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Total Project Cost, $	After ENR Cost Indexation[a,b] $2,000
Auburn Valley Project	5	313	90,000	0	22,500	0	9,675	122,175	244,350	85,523	329,873	35	24,365	270,000	0	67,500	0	29,025	366,525	128,284	494,809	8,883,624	$ 10,953,000

a. ENR Sept-1995, Seattle area, construction =5800
b. ENR Feb-2000, Seattle area, construction = 7151

2- Phase I option :

	CHLORINATION SYSTEM CONSTRUCTION COST											CHLORINE TANK CONSTRUCTION COSTS											
Project	Chlorine dosage, mg/l	Chlorine peak use, lbs/day	Cl system base constr cost, $	Mob/ Demob, 0%, $	Contin- gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Cl system cost w/o UFC upgrade	Cl system cost w/UFC upgrade, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Cl tank det. time, min	Cl tank vol, cf	Cl tank base constr cost, $	Mob/ Demob, 0%, $	Contin- gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Total Cl tank cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Total Project Cost, $	After ENR Cost Indexation[a,b] $2,000
Auburn Valley Project	5	196	86,000	0	21,500	0	9,245	116,745	233,490	81,722	315,212	35	15,269	230,000	0	57,500	0	24,725	312,225	109,279	421,504	6,534,506	$ 8,057,000

a. ENR Sept-1995, Seattle area, construction =5800
b. ENR Feb-2000, Seattle area, construction = 7151

TASK 4.20 - TERTIARY TREATMENT - ANNUAL O&M COSTS
CLASS A RECLAIMED WATER TREATMENT SYSTEM

1- Complete project: ***Assuming enough sewage available***

Project	Average capacity	ALUM CHEMICAL COSTS[a]						POLYMER CHEMICAL COSTS[a]						ALUM/POLYMER FEED SYSTEM POWER				ALUM/POLYMER O&M		TOTAL	FILTER O&M		FILTER LABOR[a]					FILTER POWER		
		Alum dosage,	Alum use,	Annual use,	Annual vol,	Alum cost,	Annual alum	Polymer dosage,	Polymer use,	Annual use,	Annual vol,	Polymer cost,	Annual Polymer	alum/polymer feed power	annual power req's	cost per kw-hr,	annual pump power	Alim/polymer feed syst.	O&M costs,	ALUM/ POLYMER	Total Filter const	O&M costs,	Filter labor,	annual usage	actual annual	labor cost	annual Filter	Filter power use,	cost per kw-hr,	annual Filter
	MGD	mg/l	lbs/day	%	tons	$/ton	cost, $	mg/l	lbs/day	%	tons	$/ton	cost, $	req's, hp	kw-hr	$	cost, $	const cost,$	$	O&M, $	cost, $	$	hrs/year	%	labor, hrs	$/hr	labor cost, $	kwh/year	$	power, $
Auburn Valley Project	4.7	150	5884	42%	448	140	62,689	0.5	19.61	42%	1.49	4,000	5,970	2.5	16,286	0.034	554	750,000	3,750	72,963	4,832,700	24,164	3,500	42%	1,460	45	65,678	470,000	0.034	15,980

a. Assumes irrigation operations 5 months/year.

2- Phase I option : ***Based on current available sewage flow (oversized for future)***

Project	Average capacity	ALUM CHEMICAL COSTS[a]						POLYMER CHEMICAL COSTS[a]						ALUM/POLYMER FEED SYSTEM POWER				ALUM/POLYMER O&M		TOTAL	FILTER O&M		FILTER LABOR[a]					FILTER POWER		
		Alum dosage,	Alum use,	Annual use,	Annual vol,	Alum cost,	Annual alum	Polymer dosage,	Polymer use,	Annual use,	Annual vol,	Polymer cost,	Annual Polymer	alum/polymer feed power	annual power req's	cost per kw-hr,	annual pump power	Alim/polymer feed syst.	O&M costs,	ALUM/ POLYMER	Total Filter const	O&M costs,	Filter labor,	annual usage	actual annual	labor cost	annual Filter	Filter power use,	cost per kw-hr,	annual Filter
	MGD	mg/l	lbs/day	%	tons	$/ton	cost, $	mg/l	lbs/day	%	tons	$/ton	cost, $	req's, hp	kw-hr	$	cost, $	const cost,$	$	O&M, $	cost, $	$	hrs/year	%	labor, hrs	$/hr	labor cost, $	kwh/year	$	power, $
Auburn Valley Project	2.93	150	3668	42%	279	140	39,081	0.5	12.23	42%	0.93	4,000	3,722	2.5	16,286	0.034	554	700,000	3,500	46,856	3,305,513	16,528	2,500	42%	1,043	45	46,913	293,000	0.034	9,962

a. Assumes irrigation operations 5 months/year.

TASK 4.20 - TERTIARY TI
CLASS A RECLAIMED W,

1- Complete project:

Project	TOTAL FILTER O&M COST, $	FILTER FEED PUMP POWER[a] Filter TDH, ft	overall pump efficiency, %	annual power req's @ peak flow, kw-hr	annual pump usage, %	actual annual power req's, kw-hr	cost per kw-hr, $	annual pump power cost, $
Auburn Valley Project	105,821	30	75%	215,545	42%	89,882	0.034	3,056

2- Phase I option :

Project	TOTAL FILTER O&M COST, $	FILTER FEED PUMP POWER[a] Filter TDH, ft	overall pump efficiency, %	annual power req's @ peak flow, kw-hr	annual pump usage, %	actual annual power req's, kw-hr	cost per kw-hr, $	annual pump power cost, $
Auburn Valley Project	73,402	30	75%	134,372	42%	56,033	0.034	1,905

TASK 4.20 - TERTIARY TI
CLASS A RECLAIMED W.

1- Complete project:

	FILTER FEED PUMP LABOR[a]					FILTER FEED O&M		TOTAL	CHLORINE FEED SYSTEM O&M					CHLORINE FEED SYSTEM LABOR[a]					CHLORINE CHEMICAL COSTS[a]						CONTACT TANK		TOTAL	TOTAL	After
Project	peak flow annual labor req's, hrs	annual usage %	actual annual labor, hrs	labor cost $/hr	annual pump O&M labor cost, $	Total feed pumps constr cost, $	O&M costs, $	FILTER FEED SYST O&M, $	CI system cost w/UFC upgrade, $	O&M costs, $	CI system power use, kwh/year	cost per kw-hr, $	annual CI syst power, $	CI system labor, hrs/year	annual usage %	actual annual labor, hrs	labor cost $/hr	annual CI system labor cost, $	Chlorine dosage, mg/l	Chlorine peak use, lbs/day	Annual use, %	Annual vol, tons	Chlorine cost, $/ton	Annual Chlorine cost, $	Total CI tank cost, $	O&M costs, $	CHLORINE SYST O&M, $	CLASS A SYSTEM O&M, 1995$	ENR Cost Indexation[b,c] $2,000
Auburn Valley Project	700	42%	292	45	13,136	386,888	1,934	18,126	244,350	1,222	18,000	0.034	612	1,000	42%	417	45	18,765	5	196.13	42%	14.93	200	2,985	366,525	1,833	25,417	222,326	$ 275,000

a. Assumes irrigation operations 5 months/year.
b. ENR Sept-1995, Seattle area, construction =5800
c. ENR Feb-2000, Seattle area, construction = 7151

2- Phase I option :

	FILTER FEED PUMP LABOR[a]					FILTER FEED O&M		TOTAL	CHLORINE FEED SYSTEM O&M					CHLORINE FEED SYSTEM LABOR[a]					CHLORINE CHEMICAL COSTS[a]						CONTACT TANK		TOTAL	TOTAL	After
Project	peak flow annual labor req's, hrs	annual usage %	actual annual labor, hrs	labor cost $/hr	annual pump O&M labor cost, $	Total feed pumps constr cost, $	O&M costs, $	FILTER FEED SYST O&M, $	CI system cost w/UFC upgrade, $	O&M costs, $	CI system power use, kwh/year	cost per kw-hr, $	annual CI syst power, $	CI system labor, hrs/year	annual usage %	actual annual labor, hrs	labor cost $/hr	annual CI system labor cost, $	Chlorine dosage, mg/l	Chlorine peak use, lbs/day	Annual use, %	Annual vol, tons	Chlorine cost, $/ton	Annual Chlorine cost, $	Total CI tank cost, $	O&M costs, $	CHLORINE SYST O&M, $	CLASS A SYSTEM O&M, 1995$	ENR Cost Indexation[b,c] $2,000
Auburn Valley Project	600	42%	250	45	11,259	289,148	1,446	14,610	233,490	1,167	13,500	0.034	459	850	42%	354	45	15,950	5	122.27	42%	9.30	200	1,861	312,225	1,561	20,999	155,867	$ 193,000

a. Assumes irrigation operations 5 months/year.
b. ENR Sept-1995, Seattle area, construction =5800
c. ENR Feb-2000, Seattle area, construction = 7151

TASK 4.20 - SECONDARY TREATMENT PLANT COSTS
CLASS A RECLAIMED WATER TREATMENT SYSTEM

1- Complete project: ***Assuming enough sewage available***

		SECONDARY TREATMENT PLANT								LIFT STATION									
Project	Plant capacity MGD	Base construction cost, $	Mob/ Demob, 0%, $	Contin-gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Secondary WWTP constr. cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Lift station base costs $	Mob/ Demob, 0%, $	Contin-gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Lift station constr. cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	TOTAL PROJECT COST, 1995$	After ENR Cost Indexation[a, b] $2,000
Auburn Valley Project	7.5	17,000,000	0	4,250,000	0	1,827,500	23,077,500	8,077,125	31,154,625	1,677,000	0	419,250	0	180,278	2,276,528	796,785	3,073,312	34,227,937	$ 42,201,000

a. ENR Sept-1995, Seattle area, construction =5800
b. ENR Feb-2000, Seattle area, construction = 7151

2- Phase I option : ***Based on current available sewage flow (oversized for future)***

		SECONDARY TREATMENT PLANT								LIFT STATION									
Project	Plant capacity MGD	Base construction cost, $	Mob/ Demob, 0%, $	Contin-gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Secondary WWTP constr. cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Lift station base costs $	Mob/ Demob, 0%, $	Contin-gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Lift station constr. cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	TOTAL PROJECT COST, 1995$	After ENR Cost Indexation[a, b] $2,000
Auburn Valley Project	4.7	12,500,000	0	3,125,000	0	1,343,750	16,968,750	5,939,063	22,907,813	1,175,000	0	293,750	0	126,313	1,595,063	558,272	2,153,334	25,061,147	$ 30,899,000

a. ENR Sept-1995, Seattle area, construction =5800
b. ENR Feb-2000, Seattle area, construction = 7151

TASK 4.20 - SECONDARY TREATMENT PLANT O&M COSTS
CLASS A RECLAIMED WATER TREATMENT SYSTEM

1- Complete project: ***Assuming enough sewage available***

Project	Average capacity MGD	WWTP O&M cost[a], $	Lift Sta O&M cost, $	Total O&M cost, $	After ENR cost Indexation[b,c] $2,000
Auburn Valley Project	4.7	286,700	44,000	330,700	$ 408,000

a. Assumes irrigation operations 5 months/year.
b. ENR Sept-1995, Seattle area, construction =5800
c. ENR Feb-2000, Seattle area, construction = 7151

2- Phase I option : ***Based on current available sewage flow (oversized for future)***

Project	Average capacity MGD	WWTP O&M cost[a], $	Lift Sta O&M cost, $	Total O&M cost, $	After ENR cost Indexation[b,c] $2,000
Auburn Valley Project	2.93	178,730	38,000	216,730	$ 268,000

a. Assumes irrigation operations 5 months/year.
b. ENR Sept-1995, Seattle area, construction =5800
c. ENR Feb-2000, Seattle area, construction = 7151

RECLAIMED WATER ASSISTANCE PROGRAM

1- Complete project: ***Assuming enough sewage available***

CALCULATION OF LEVELIZED UNIT COSTS

Design Flow =	7.5	Discount Rate =	3%
Average Flow, MGD =	4.7	Interest Rate for Debt Service =	6.25%
Distribution Length, ft =	54,380	Life Cycle, years =	35
Water Quality Class =	A	Irrigation period, months/yr =	5

	CAPITAL COSTS, 2000 $[a]				O&M COSTS, 2000 $					Salvage Value, 2000 $[c]								
Year	Distribution	Tertiary	Secondary	Total	Distribution	Tertiary	Secondary	Operating capacity	Total O&M costs, 2000 $	Distribution	Tertiary	Secondary	Annualized Debt Service, 2000 $[b]	Annual Cash Flow, 2000$	Annual Cash Flow P.Worth, 2000 $	CCF produced per Year	Equiv. Annual Costs, 2000 $	Annual unit cost, $/CCf
1	(16,941,000)	(10,953,000)	(42,201,000)	(70,095,000)				0%	0				(4,977,254)	(70,095,000)	(70,095,000)	0	(4,832,286)	N.A.
2					(108,000)	(275,000)	(408,000)	50%	(395,500)				(4,977,254)	(395,500)	(372,797)	479,147	(5,087,039)	(10.6)
3					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(723,877)	958,295	(5,345,893)	(5.6)
4					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(702,793)	958,295	(5,213,226)	(5.4)
5					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(682,324)	958,295	(5,084,423)	(5.3)
6					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(662,450)	958,295	(4,959,372)	(5.2)
7					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(643,155)	958,295	(4,837,963)	(5.0)
8					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(624,423)	958,295	(4,720,090)	(4.9)
9					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(606,236)	958,295	(4,605,651)	(4.8)
10					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(588,578)	958,295	(4,494,545)	(4.7)
11					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(571,435)	958,295	(4,386,674)	(4.6)
12					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(554,791)	958,295	(4,281,946)	(4.5)
13					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(538,633)	958,295	(4,180,268)	(4.4)
14					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(522,944)	958,295	(4,081,551)	(4.3)
15					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(507,713)	958,295	(3,985,710)	(4.2)
16					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(492,925)	958,295	(3,892,660)	(4.1)
17					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(478,568)	958,295	(3,802,321)	(4.0)
18					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(464,629)	958,295	(3,714,612)	(3.9)
19					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(451,096)	958,295	(3,629,459)	(3.8)
20					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(437,958)	958,295	(3,546,785)	(3.7)
21					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(425,201)	958,295	(3,466,519)	(3.6)
22					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(412,817)	958,295	(3,388,592)	(3.5)
23					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(400,793)	958,295	(3,312,934)	(3.5)
24					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(389,120)	958,295	(3,239,479)	(3.4)
25					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(377,786)	958,295	(3,168,164)	(3.3)
26					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(366,783)	958,295	(3,098,927)	(3.2)
27					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(356,100)	958,295	(3,031,705)	(3.2)
28					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(345,728)	958,295	(2,966,442)	(3.1)
29					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(335,658)	958,295	(2,903,080)	(3.0)
30					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(325,882)	958,295	(2,841,563)	(3.0)
31					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(316,390)	958,295	(2,781,838)	(2.9)
32					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(307,175)	958,295	(2,723,852)	(2.8)
33					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(298,228)	958,295	(2,667,555)	(2.8)
34					(108,000)	(275,000)	(408,000)	100%	(791,000)				(4,977,254)	(791,000)	(289,542)	958,295	(2,612,899)	(2.7)
35					(108,000)	(275,000)	(408,000)	100%	(791,000)	7,228,160	2,920,800	11,253,600	(4,977,254)	20,611,560	7,325,006	958,295	5,046,281	5.3
													Total:		(78,344,519)	32,102,874	(125,839,742)	
																	Levelized Unit Cost in 2000 $, $/ccf:	**(3.92)**

a. It is assumed that 80% of the distribution system facilities and 50% of the treatment facilities are considered static facilities with a 35 years useful life. To be consistent with the Regional Wastewater Services Plan (RWSP), replacement of non static facilities is assumed after 35 years of operation.

b. Assumes a 6.25% interest rate for annualized capital recovery with equal payments over 35 years.

c. Salvage value based on static facilities having a 75-year useful life, using straight line depreciation.

RECLAIMED WATER ASSISTANCE PROGRAM

2- Phase I option : ***Based on current available sewage flow (oversized for future)***

CALCULATION OF LEVELIZED UNIT COSTS

Design Flow =	4.7	Discount Rate =	3%
Average Flow, MGD =	2.93	Interest Rate for Debt Service =	6.25%
Distribution Length, ft =	26,700	Life Cycle, years =	35
Water Quality Class =	A	Irrigation period, months/yr =	5

	CAPITAL COSTS, 2000 $[a]				O&M COSTS, 2000 $					Salvage Value, 2000 $[c]								
Year	Distribution	Tertiary	Secondary	Total	Distribution	Tertiary	Secondary	Operating capacity	Total O&M costs, 2000 $	Distribution	Tertiary	Secondary	Annualized Debt Service, 2000 $[b]	Annual Cash Flow, 2000$	Annual Cash Flow P.Worth, 2000 $	CCF produced per Year	Equiv. Annual Costs, 2000 $	Annual unit cost, $/CCf
1	(13,068,000)	(8,057,000)	(30,899,000)	(52,024,000)				0%	0				(3,694,082)	(52,024,000)	(52,024,000)	0	(3,586,487)	N.A.
2					(77,000)	(193,000)	(268,000)	50%	(269,000)				(3,694,082)	(269,000)	(253,558)	298,703	(3,751,027)	(12.6)
3					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(492,346)	597,405	(3,918,608)	(6.6)
4					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(478,006)	597,405	(3,820,144)	(6.4)
5					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(464,084)	597,405	(3,724,548)	(6.2)
6					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(450,567)	597,405	(3,631,735)	(6.1)
7					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(437,443)	597,405	(3,541,627)	(5.9)
8					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(424,702)	597,405	(3,454,142)	(5.8)
9					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(412,332)	597,405	(3,369,206)	(5.6)
10					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(400,323)	597,405	(3,286,744)	(5.5)
11					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(388,663)	597,405	(3,206,683)	(5.4)
12					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(377,342)	597,405	(3,128,955)	(5.2)
13					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(366,352)	597,405	(3,053,490)	(5.1)
14					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(355,681)	597,405	(2,980,223)	(5.0)
15					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(345,322)	597,405	(2,909,091)	(4.9)
16					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(335,264)	597,405	(2,840,030)	(4.8)
17					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(325,499)	597,405	(2,772,980)	(4.6)
18					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(316,018)	597,405	(2,707,884)	(4.5)
19					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(306,814)	597,405	(2,644,683)	(4.4)
20					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(297,878)	597,405	(2,583,324)	(4.3)
21					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(289,202)	597,405	(2,523,751)	(4.2)
22					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(280,778)	597,405	(2,465,914)	(4.1)
23					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(272,600)	597,405	(2,409,761)	(4.0)
24					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(264,660)	597,405	(2,355,244)	(3.9)
25					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(256,952)	597,405	(2,302,314)	(3.9)
26					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(249,468)	597,405	(2,250,926)	(3.8)
27					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(242,202)	597,405	(2,201,035)	(3.7)
28					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(235,147)	597,405	(2,152,597)	(3.6)
29					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(228,298)	597,405	(2,105,570)	(3.5)
30					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(221,649)	597,405	(2,059,913)	(3.4)
31					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(215,193)	597,405	(2,015,585)	(3.4)
32					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(208,925)	597,405	(1,972,549)	(3.3)
33					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(202,840)	597,405	(1,930,766)	(3.2)
34					(77,000)	(193,000)	(268,000)	100%	(538,000)				(3,694,082)	(538,000)	(196,932)	597,405	(1,890,200)	(3.2)
35					(77,000)	(193,000)	(268,000)	100%	(538,000)	5,575,680	2,148,533	8,239,733	(3,694,082)	15,425,947	5,482,125	597,405	3,822,506	6.4
														Total:	(57,134,914)	20,013,068	(91,725,230)	
																	Levelized Unit Cost in 2000 $, $/ccf:	(4.58)

a. It is assumed that 80% of the distribution system facilities and 50% of the treatment facilities are considered static facilities with a 35 years useful life. To be consistent with the Regional Wastewater Services Plan (RWSP), replacement of non static facilities is assumed after 35 years of operation.

b. Assumes a 6.25% interest rate for annualized capital recovery with equal payments over 35 years.

c. Salvage value based on static facilities having a 75-year useful life, using straight line depreciation.

TASK 4.30 - DISTRIBUTION SYSTEM COSTS - CONSTRUCTION COSTS

Includes pumps and pipeline from the the South Treatment plant to each identified user in the Auburn Valley

1- Complete project: ***From South Treatment Plant to all users***

Project	Pipe Routing	Plant capacity MGD	Piping length L (ft)	Pump Station costs: Flow for Pipe sizing[b] MGD	D inches	v ft/sec	Manning's n	Manning's friction loss Hf (ft)	static head ft	Delivered P requ'd ft	TDH[c] ft	Base pump sta. constr, $	Mob/ Demob, 0%, $	Contin-gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Total pump sta. constr cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $
Auburn Valley Project[a]	Total flow, to Frager Rd Nursery	7.5	40,000	7.80	24	3.85	0.010	**68**	20	20	260	1,380,000	0	345,000	0	148,350	1,873,350	655,673	2,529,023
	From Nursery to BallFields		2,940	0.33	4	5.86	0.010	126											
	From Nursery to Riverbend GC		3,050	7.35	18	6.45	0.010	**21**											
	From Riverbend GC to Tree Farm		3,840	6.38	18	5.60	0.010	**20**											
	From Tree Farm to West Pastures and Crops split (1)		7,000	6.31	18	5.54	0.010	**36**											
	West Pastures and Crops pipe (a)		1,900	1.34	8	5.95	0.010	33											
	West Pastures and Crops pipe (b)		1,900	1.34	8	5.95	0.010	33											
	From (1) to (2) Southwest pastures and crops		2,100	1.88	10	5.35	0.010	**22**											
	From (2) to Southwest pastures and crops		4,000	0.54	6	4.26	0.010	**53**											
	From (1) to East pastures&crops		6,300	3.09	14	4.48	0.010	**30**	20	20	193	750,000 (Booster Pump)	0	187,500	0	80,625	1,018,125	356,344	1,374,469
	Pastures and crops' pipe		1,200	1.41	8	6.26	0.010	23											
	From East pastures and crops to Playfields		4,500	1.68	10	4.78	0.010	**38**											
	From Green River Playfields to Green River Nursery		1,200	1.51	10	4.29	0.010	**8**											
	From Green River Nursery to (5) (pastures and crops)		7,750	1.49	10	4.24	0.010	**51**											
	Pastures and crops' pipe		800	0.40	4	7.11	0.010	50											
	From (5) to Auburn GC		2,300	1.10	8	4.89	0.010	**27**											

a.The reclaimed water produced is distributed to multiple users; distribution line costs are calculated for various section and added to give total cost.

b. Distribution lines are sized to provide peak hour demand to non golf course users and peak day demand to golf course users. Non golf course users and parks peak day demand based on 24 hr per 24hr irrigation time. Golf courses and parks (e.g. playfields) peak day demand based on 10 hr per 24 hr irrigation time.

c. Includes Manning's friction losses in **bold**

Mob/Demob=	0.0%
Contingency =	25.0%
Sales tax =	8.6%
ELA =	35.0%
Contractor O&P=	0.0%

TASK 4.30 - DISTRIBUTION SYSTEM COSTS - CONSTRUCTION COSTS

Includes pumps and pipeline from the the South Treatment plant to each identified user in the Aubur

1- Complete project: ***From South Treatment Plant to all users***

Project	Pipe Routing	Pipeline construction costs									Storage construction costs[d]										
		pipeline unit cost, $/lf	base pipe constr cost, $	Mob/ Demob, 0%, $	Contin-gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Total pipeline constr cost,$	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Irrigation storage vol, MG	base storage tank constr cost, $	Mob/ Demob, 0%, $	Contin-gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Storage tank construction cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Total Project cost in 1995 $	After ENR Indexation[e,f] in $ 2000
Auburn Valley Project[a]	Total flow, to Frager Rd Nursery	120	4,800,000	0	1,659,303	0	713,500	9,010,013	3,832,719	14,783,346	4.7	2,351,250	0	587,813	0	252,759	3,191,822	1,117,138	4,308,960	21,621,328	$ 26,658,000
	From Nursery to BallFields	42	123,480						(Includes both sections)												
	From Nursery to Riverbend GC	87	265,350																		
	From Riverbend GC to Tree Farm	87	334,080																		
	From Tree Farm to West Pastures and Crops split (1)	87	609,000																		
	West Pastures and Crops pipe (a)	52	98,800																		
	West Pastures and Crops pipe (b)	52	98,800																		
	From (1) to (2) Southwest pastures and crops	57	119,700																		
	From (2) to Southwest pastures and crops	47	188,000																		
	From (1) to East pastures&crops	71	447,300	0	357,388	0	153,677	1,940,614													
	Pastures and crops' pipe	52	62,400																		
	From East pastures and crops to Playfields	57	256,500																		
	From Green River Playfields to Green River Nursery	57	68,400																		
	From Green River Nursery to (5) (pastures and crops)	57	441,750																		
	Pastures and crops' pipe	42	33,600																		
	From (5) to Auburn GC	52	119,600																		

a.The reclaimed water produced is distributed to multiple users; distribution line costs are calculated for various section and added to give total cost.

b. Distribution lines are sized to provide peak hour demand to non golf course users and peak day demand to golf course users. Non golf course users and parks peak day demand based on 24 hr per 24hr irrigation time. Golf courses and parks (e.g. playfields) peak day demand based on 10 hr per 24 hr irrigation time.

c. Includes Manning's friction losses in **bold**

d. It is assumed that storage is not necessary at golf course locations where existing ponds can be used for reclamation water storage.

e. ENR Sept-1995, Seattle area, construction =5800

f. ENR Feb-2000, Seattle area, construction = 7151

TASK 4.30 - DISTRIBUTION SYSTEM COSTS - ANNUAL O&M COSTS

1- Complete project: *From South Treatment Plant to all users*

			ANNUAL PUMPING STATION O&M COSTS[a]														ANNUAL PIPELINE O&M[b]		ANNUAL STORAGE O&M[b]			
Project	Average volume MGD	Total Piping L (ft)	Total pump sta. construction costs, $	annual pump maintenance costs, 1995 US$	TDH ft	overall pump efficiency, %	annual power req's @ peak flow, kw-hr	annual pump usage, %[a]	actual annual power req's, kw-hr	cost per kw-hr, $	annual pump power cost, 1995 US$	peak flow annual labor req's, hrs	annual usage %[a]	actual annual labor, hrs	labor cost $/hr	annual pump O&M labor cost, $	Total annual pump O&M costs, $	Total pipeline construction costs, $	annual pipe maintenance costs, 1995 US$	Storage tank Construction costs, $	annual storage tank maint. costs, $	Total annual distribution system O&M costs, $/year	After ENR Cost Indexation[c,d] $2,000
Auburn Valley Project	4.7	90,780	1,873,350	9,367	453	75%	3,254,462	42%	1,357,111	0.034	46,142	1,200	42%	500	45	22,518	78,027	10,950,627	54,753	3,191,822	15,959	148,739	$ 184,000

a. Assumes irrigation operations 5 months/year
b. It is assumed that storage is not necessary at golf course locations where existing ponds can be used for reclamation water storage.
c. ENR Sept-1995, Seattle area, construction =5800
d. ENR Feb-2000, Seattle area, construction = 7151

TASK 4.20 - TERTIARY TREATMENT CAPITAL COSTS
CLASS A RECLAIMED WATER TREATMENT SYSTEM

1- Complete project: ***From South Treatment Plant to all users***

		FILTER CHEMICAL FEED SYSTEM			FILTER FEED PUMPS											FILTERS									
Project	Plant capacity MGD	Alum/polymer feed syst. constr cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Friction head loss, ft	static head ft	TDH ft	Base pump sta. constr, $[a]	Mob/ Demob, 0%, $	Contin-gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Total feed pumps constr cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Filter loading rate gpm/sf	Filter surface area, sf	Base filter constr. cost, $	Mob/ Demob, 0%, $	Contin-gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Total filter constr cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $
Auburn Valley Project	7.5	750,000	262,500	1,012,500	10	20	30	570,000	0	142,500	0	61,275	773,775	270,821	1,044,596	3.5	1488	3,560,000	0	890,000	0	382,700	4,832,700	1,691,445	6,524,145

a. Includes additional filter effluent pump to pump into above ground storage tank.

TASK 4.20 - TERTIARY TRE
CLASS A RECLAIMED WAT

1- Complete project:

	CHLORINATION SYSTEM CONSTRUCTION COST											CHLORINE TANK CONSTRUCTION COSTS											
Project	Chlorine dosage, mg/l	Chlorine peak use, lbs/day	Cl system base constr cost, $	Mob/ Demob, 0%, $	Contin- gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Cl system cost w/o UFC upgrade	Cl system cost w/UFC upgrade, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Cl tank det. time, min	Cl tank vol, cf	Cl tank base constr cost, $	Mob/ Demob, 0%, $	Contin- gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Total Cl tank cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Total Project Cost, $	After ENR Cost Indexation[a,b] $2,000
Auburn Valley Project	5	313	90,000	0	22,500	0	9,675	122,175	244,350	85,523	329,873	35	24,365	270,000	0	67,500	0	29,025	366,525	128,284	494,809	9,405,923	$ 11,597,000

a. ENR Sept-1995, Seattle area, construction =5800
b. ENR Feb-2000, Seattle area, construction = 7151

TASK 4.30 - TERTIARY TREATMENT - ANNUAL O&M COSTS
CLASS A RECLAIMED WATER TREATMENT SYSTEM

1- Complete project: ***From South Treatment Plant to all users***

		ALUM CHEMICAL COSTS[a]						POLYMER CHEMICAL COSTS[a]						ALUM/POLYMER FEED SYSTEM POWER				ALUM/POLYMER O&M		TOTAL	FILTER O&M		FILTER LABOR[a]					FILTER POWER			TOTAL	FILTER FEED PUMP POWER[a]						
Project	Average capacity MGD	Alum dosage, mg/l	Alum use, lbs/day	Annual use, %	Annual vol, tons	Alum cost, $/ton	Annual alum cost, $	Polymer dosage, mg/l	Polymer use, lbs/day	Annual use, %	Annual vol, tons	Polymer cost, $/ton	Annual Polymer cost, $	alum/polymer feed power req's, hp	annual power req's kw-hr	cost per kw-hr, $	annual pump power cost, $	Alum/polymer feed syst. const cost,$	O&M costs, $	ALUM/ POLYMER O&M, $	Total Filter const cost, $	O&M costs, $	Filter labor, hrs/year	annual usage %	actual annual labor, hrs	labor cost $/hr	annual Filter labor cost, $	Filter power use, kwh/year	cost per kw-hr, $	annual Filter power, $	FILTER O&M COST, $	Filter TDH, ft	overall pump efficiency, %	annual power req's @ peak flow, kw-hr[c]	annual pump usage, %	actual annual power req's, kw-hr	cost per kw-hr, $	annual pump power cost, $
Auburn Valley Project	4.7	150	5884	42%	448	140	62,689	0.5	19.61	42%	1.49	4,000	5,970	2.5	16,286	0.034	554	750,000	3,750	72,963	4,832,700	24,164	3,500	42%	1,460	45	65,678	470,000	0.034	15,980	105,821	30	75%	431,090	42%	179,765	0.034	6,112

a. Assumes irrigation operations 5 months/year.

c. Includes power for filter effluent/storage tank feed pump

TASK 4.30 - TERTIARY T
CLASS A RECLAIMED W.

1- Complete project:

	FILTER FEED PUMP LABOR[a]					FILTER FEED O&M		TOTAL	CHLORINE FEED SYSTEM O&M					CHLORINE FEED SYSTEM LABOR[a]					CHLORINE CHEMICAL COSTS[a]						CONTACT TANK		TOTAL	TOTAL	After
Project	peak flow annual labor req's, hrs	annual usage %	actual annual labor, hrs	labor cost $/hr	annual pump O&M labor cost, $	Total feed pumps constr cost, $	O&M costs, $	FILTER FEED SYST O&M, $	Cl system cost w/UFC upgrade, $	O&M costs, $	Cl system power use, kwh/year	cost per kw-hr, $	annual Cl syst power, $	Cl system labor, hrs/year	annual usage %	actual annual labor, hrs	labor cost $/hr	annual Cl system labor cost, $	Chlorine dosage, mg/l	Chlorine peak use, lbs/day	Annual use, %	Annual vol, tons	Chlorine cost, $/ton	Annual Chlorine cost, $	Total Cl tank cost, $	O&M costs, $	CHLORINE SYST O&M, $	CLASS A SYSTEM O&M, 1995$	ENR Cost Indexation[b,c] $2,000
Auburn Valley Project	1,400	42%	584	45	26,271	773,775	3,869	36,252	244,350	1,222	18,000	0.034	612	1,000	42%	417	45	18,765	5	196.13	42%	14.93	200	2,985	366,525	1,833	25,417	240,452	$ 297,000

a. Assumes irrigation operations 5 months/year.

b. ENR Sept-1995, Seattle area, construction =5800

c. ENR Feb-2000, Seattle area, construction = 7151

RECLAIMED WATER ASSISTANCE PROGRAM
LIFE CYCLE COSTS ESTIMATION
AUBURN VALLEY PROJECT

1- Complete project: ***From South Treatment Plant to all users***

CALCULATION OF LEVELIZED UNIT COSTS

Design Flow =	7.5	Discount Rate =	3%
Average Flow, MGD =	4.7	Interest Rate for Debt Service =	6.25%
Distribution Length, ft =	90,780	Life Cycle, years =	35
Water Quality Class =	A	Irrigation period, months/yr =	5

	CAPITAL COSTS, 2000 $[a]				O&M COSTS, 2000 $					Salvage Value, 2000 $[c]								
Year	Distribution	Tertiary	Secondary	Total	Distribution	Tertiary	Secondary	Operating capacity	Total O&M costs, 2000 $	Distribution	Tertiary	Secondary	Annualized Debt Service, 2000 $[b]	Annual Cash Flow, 2000$	Annual Cash Flow P.Worth, 2000 $	CCF produced per Year	Equiv. Annual Costs, 2000 $	Annual unit cost, $/CCf
1	(26,658,000)	(11,597,000)	0	(38,255,000)				0%	0				(2,716,383)	(38,255,000)	(38,255,000)	0	(2,637,265)	N.A.
2					(184,000)	(297,000)	0	50%	(240,500)				(2,716,383)	(240,500)	(226,694)	479,147	(2,800,951)	(5.8)
3					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(440,183)	958,295	(2,966,875)	(3.1)
4					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(427,362)	958,295	(2,894,471)	(3.0)
5					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(414,915)	958,295	(2,824,176)	(2.9)
6					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(402,830)	958,295	(2,755,928)	(2.9)
7					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(391,097)	958,295	(2,689,668)	(2.8)
8					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(379,706)	958,295	(2,625,338)	(2.7)
9					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(368,646)	958,295	(2,562,881)	(2.7)
10					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(357,909)	958,295	(2,502,244)	(2.6)
11					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(347,485)	958,295	(2,443,373)	(2.5)
12					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(337,364)	958,295	(2,386,216)	(2.5)
13					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(327,538)	958,295	(2,330,725)	(2.4)
14					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(317,998)	958,295	(2,276,849)	(2.4)
15					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(308,736)	958,295	(2,224,543)	(2.3)
16					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(299,743)	958,295	(2,173,760)	(2.3)
17					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(291,013)	958,295	(2,124,456)	(2.2)
18					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(282,537)	958,295	(2,076,589)	(2.2)
19					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(274,308)	958,295	(2,030,115)	(2.1)
20					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(266,318)	958,295	(1,984,995)	(2.1)
21					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(258,561)	958,295	(1,941,190)	(2.0)
22					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(251,030)	958,295	(1,898,660)	(2.0)
23					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(243,719)	958,295	(1,857,369)	(1.9)
24					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(236,620)	958,295	(1,817,280)	(1.9)
25					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(229,728)	958,295	(1,778,360)	(1.9)
26					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(223,037)	958,295	(1,740,572)	(1.8)
27					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(216,541)	958,295	(1,703,886)	(1.8)
28					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(210,234)	958,295	(1,668,268)	(1.7)
29					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(204,111)	958,295	(1,633,687)	(1.7)
30					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(198,166)	958,295	(1,600,114)	(1.7)
31					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(192,394)	958,295	(1,567,518)	(1.6)
32					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(186,790)	958,295	(1,535,872)	(1.6)
33					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(181,350)	958,295	(1,505,148)	(1.6)
34					(184,000)	(297,000)	0	100%	(481,000)				(2,716,383)	(481,000)	(176,068)	958,295	(1,475,318)	(1.5)
35					(184,000)	(297,000)	0	100%	(481,000)	11,374,080	3,092,533	0	(2,716,383)	13,985,613	4,970,255	958,295	(1,446,357)	(1.5)
														Total:	(42,755,474)	32,102,874	(74,481,017)	
																	Levelized Unit Cost in 2000 $, $/ccf:	**(2.32)**

a. It is assumed that 80% of the distribution system facilities and 50% of the treatment facilities are considered static facilities with a 35 years useful life. To be consistent with the Regional Wastewater Services Plan (RWSP), replacement of non static facilities is assumed after 35 years of operation.

b. Assumes a 6.25% interest rate for annualized capital recovery with equal payments over 35 years.

c. Salvage value based on static facilities having a 75-year useful life, using straight line depreciation.

King County Reclaimed Water Assistance Program

Sammamish River Water Reuse Project Reevaluation

PREPARED FOR: Tom Fox/ KCDNR

PREPARED BY: Bill Persich/Brown and Caldwell
Dave Parkinson/CH2M HILL

COPIES Rick Kirkby/KCDNR
Greg Bush/KCDNR
John Smyth/KCDNR

DATE: August 31, 2000

Background

In the *Identification of Potential Satellite Projects for Direct Non-Potable Uses: Draft Summary Report*, July 2000, the Sammamish River Water Reuse project was considered to be a project that could meet the goals of the Demonstration Phase. However, the estimated capital cost of the project was $43 million. The Task Force has since requested that KCDNR investigate a smaller version of the project to reduce the overall capital costs and be more in line with the $20 million proposed by the King County Council to fund the water reuse program. This technical memorandum summarizes the development of the reduced Sammamish River Water Reuse project now designated as Phase 1.

Sammamish River Reuse Project Reevaluation

The original Sammamish River Reuse Project presented in TM 420 includes users all along the Sammamish River and extends from Marymoor Park up to Gold Creek Parks. In this reevaluation, only the capacity, number of users and costs are being revised. All other information presented in Technical Memorandum 410 of the *Identification of Potential Satellite Projects for Direct Non-Potable Uses: Draft Appendices* remains the same. As a reminder, this evaluation assumes that the potential reclaimed water plant would be located near the York pumping station.

In order to reduce the capital costs of the project, a Sammamish River -"Phase 1"- project has been evaluated. This Phase 1 assumes that the satellite plant capacity could be increased to serve all irrigation water users in the future by adding modules to the process. For this reason, pipeline sizes were oversized to accommodate future expansion. To minimize the costs, the project has been limited to provide reclaimed water to the nearest users to the satellite plant. Table 1 lists the reclaimed water users that were originally identified in the Sammamish River Valley and highlights the users retained for this evaluation (data from TM 420).

TABLE 1.
Flow Demand and Selected[a] Reclaimed Water Users - Phase 1

Potential Satellite Plant Location	Potential Users	Average day[b] (MGD)			PDD[c] (MGD)	PHD[d] (gpm)
		min	max	avg		
York Pumping Station (*Sammamish River*)						
	Willows Run Golf Course	**0.332**	**1.283**	**0.808**	**1.27**	**2,198**
	Farm LCC			0.201	0.31	516
	60 Acres Soccer Field			**0.171**	**0.26**	**439**
	Molbak's Greenhouse			0.026	0.04	67
	JB Instant Lawns			**1.072**	**1.65**	**2,751**
	Hmong Farm			0.201	0.31	516
	Chateau Ste. Michelle Winery			0.342	0.53	878
	Gold Creek Parks			0.107	0.16	274
Total – Phase 1				**2.05**	**3.18**	**5,388**

[a] Reclaimed water users selected for this evaluation of the Sammamish River Project -Phase 1 appear in **bold** in the table.
[b] During irrigation period (May-September)
[c] Peak day demands (PDD) are based on applying a 1.54 peaking factor to the average value of average day demand. Peaking factor calculated based on agronomic rates.
[d] Assuming a peaking factor of 2.4. PHD/PDD based on assumption of 10 hours irrigation per day.

Based on the information in Table 1, the Phase 1 reclamation facility design flow criteria would be 3.2 mgd. As in the previous evaluations, the reclaimed water demands are assumed to fluctuate through the irrigation season, with typical peak demands in July-August and an average reclaimed water demand of 2.05 mgd.

Cost Evaluation

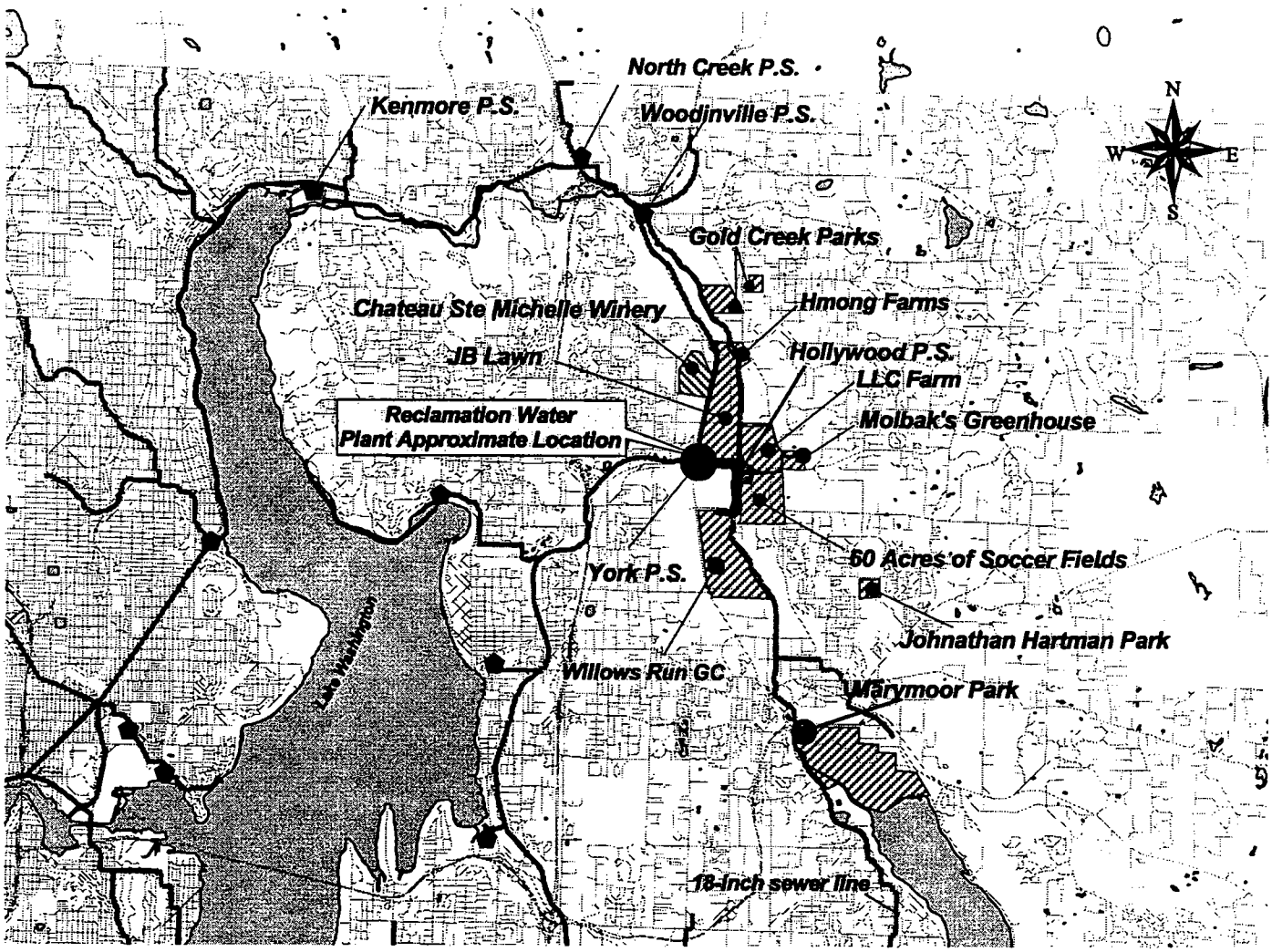
While this project is focused on determining the best means of providing the necessary treatment and conveyance of reclaimed water to potential users, this evaluation process should be considered preliminary and will be refined if the project is included in the subsequent feasibility phase. Location of the Phase 1 project and the proposed distribution pipe routing is shown in Figure 1.

Design Criteria

To develop comparable alternative costs, a number of assumptions were made regarding potential design criteria. Although these criteria are expected to be further refined in the feasibility analysis stage, preliminary criteria include operating parameters, treatment, and distribution/storage. A detailed description of the preliminary design criteria on which this cost evaluation is based can be found in TM 420.

Figure 1

Reclaimed Water Project Evaluation: Modified Sammamish River



September 2000

The most important operating parameter, aside from treatment and distribution/storage, is the operating schedule of the reclamation facilities. It is assumed that facilities are operated seasonally for summer irrigation uses, only 5 months per year (May-September). In TM 420, it was estimated that a maximum of 4.4 mgd of sewage is currently available for reclaimed water purposes[1]. Therefore, a 3.2 mgd facility in Phase 1 could readily be implemented.

The reclaimed water facilities would draw wastewater from the York pumping station for full-process liquid stream treatment, including biological secondary treatment and tertiary treatment using filtration to prepare Class A reclaimed water suitable for reuse. In this evaluation, wastewater solids derived from satellite secondary and tertiary treatment processes would be reintroduced into the sewer system for conveyance and treatment at KCDNR's South Treatment Plant (Renton). The reclaimed water distribution system includes pumps and pipelines for the conveyance and distribution of reclaimed water to potential users.

Normally, sizing of each treatment and conveyance unit is defined by peak day demand (PDD) and peak hour demand (PHD), respectively. In this Phase 1 evaluation, it was assumed that the reclaimed water would be stored at the satellite plant location to assure peak demands of JB Lawn and 60 Acres, while Willows Run's storage demand would be provided through its storage ponds. As the evaluation is further refined, the capital costs might be reduced by using the storage ponds of Willows Run for the total storage demand of the users (e.g. JB Lawn, 60 Acres, and Willows Run itself) and eliminating the storage tank at the satellite plant. This option could be evaluated in the next evaluation step. In this evaluation, the conveyance system was sized to accommodate all the potential reclaimed water users listed in Table 1, with distribution only to those identified for this Phase 1.

Estimated Costs

The method followed for cost estimation has been previously described in KCDNR's *Reclaimed Water Program Demonstration Phase: Identification of Potential Satellite Projects for Direct Non-Potable Uses, Summary and Appendices* (July 2000).

Cost analyses were performed for this alternative following the method previously established. Table 2 lists the project capital costs for the Sammamish River- Phase 1 alternative based on distribution, secondary treatment, and tertiary treatment facilities. Operations and maintenance (O&M) costs and the unit cost of producing reclaimed water (in dollars per hundred cubic feet, $/ccf) are also presented in Table 2. The estimated distribution length and seasonal operation (5 months per year) of the facilities have a large impact on these unit costs. The cost estimating spreadsheets are presented in Attachment 1.

[1] Assuming that during dry weather season, wastewater would be diverted from the Sammamish Valley Interceptor to the York pumping station (usually out of service during dry season) for reclamation water purposes.

TABLE 2
Sammamish River – Phase 1: Facility Project Costs

Item	Capital Cost (year 2000)[b]	O&M Cost[c]	Unit Cost ($/ccf)[d,e]
Distribution System[a]	$4,210,000	$38,000	
Secondary Treatment	$20,070,000	$196,000	
Tertiary Treatment	$6,240,000	$175,000	
Total	**$30,520,000**	**$409,000**	**$4.08**

[a] Includes oversized distribution system to accommodate total demand in future.

[b] Includes Contingency (25%), Sales tax (8.6%), Engr/Admin/Legal (35%).

[c] Includes pipe and pump maintenance costs with power based on 75% efficiency, storage tank maintenance costs, and chemical costs

[d] Levelized unit cost is obtained from the ratio of the total of the equivalent annual costs over a 35-year cycle divided by the total ccf of reclaimed water produced over the cycle. The equivalent annual cost includes O&M costs, salvage value, and capital recovery payments, annualized with a 3 % discount rate factor and 6.25 % interest rate. The salvage value is estimated on static facilities (80% of distribution and 50% of treatment equipment), using straight line depreciation over 75 years.

[e] It is assumed that reclaimed water demand will fluctuate during irrigation season. However, based on a constant production at full design flow, the levelized unit cost would be approximately $2.66/ccf.

Attachment 1: Cost Estimating Spreadsheets

RECLAIMED WATER ASSISTANCE PROGRAM

TASK 4.20 - DISTRIBUTION SYSTEM COSTS - CONSTRUCTION COSTS

Includes pumps and pipeline from the the satellite plant to the user

Project	Pipe Routing	Plant capacity MGD	Piping length L (ft)	Flow for Pipe sizing[b] MGD	D inches	v ft/sec	Manning's n	Manning's friction loss Hf (ft)	static head ft	Delivered P requ'd ft	TDH ft[c]	Pump Station costs: Base pump sta. constr, $[d]	Mob/ Demob, 0%, $	Contin- gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Total pump sta. constr cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $
Sammamish River Ph I[a] *(oversizing to serve up to Gold Creek in the future and oversizing South to serve Marymoor in future)*	Total, from York to Hollywood	3.18	2,500	10.29	18	9.03	0.010	**34**	20	20	152	575,000	0	143,750	0	61,813	780,563	273,197	1,053,759
	60 Acres' pipe		700	0.63	6	4.98	0.010	13											
	From Willows Run to split (future connection to Marymoor)		3,000	2.47	10	7.02	0.010	**54**											
	Willows Run's pipe		1,500	1.27	8	5.64	0.010	**24**											

a.The reclaimed water produced is distributed to multiple users; distribution line costs are calculated for various section and added to give total cost.

b. Distribution lines are sized to provide peak hour demand to non golf course users and peak day demand to golf course users.

c. Includes Manning's friction losses in **bold**

d. Pump station costs for this base Sammamish project is for short (< 10,000 ft) distribution distances

e. Provides storage for JB Lawn and 60 Acres. Storage is at the satellite plant location.

f. ENR Sept-1995, Seattle area, construction =5800

g. ENR Feb-2000, Seattle area, construction = 7151

Mob/Demob=	0.0%
Contingency =	25.0%
Sales tax =	8.6%
ELA =	35.0%
Contractor O&P=	0.0%

TASK 4.20 - DISTRIBUTION SYSTE
Includes pumps and pipeline from th

Project	Pipeline construction costs									Storage construction costs[e]									
	pipeline unit cost, $/lf	base pipe constr cost, $	Mob/ Demob, 0%, $	Contin-gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Total pipeline constr cost,$	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Irrigation storage vol, MG	base storage tank constr cost, $	Mob/ Demob, 0%, $	Contin-gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Storage tank construction cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Total Project cost in 1995 $	After ENR Indexation[f,g] in $ 2000
Sammamish River Ph I[a]	87	217,500	0	124,850	0	53,686	677,936	237,277	915,213	1.6	787,875	0	196,969	0	84,697	1,069,540	374,339	1,443,879	3,412,852	$ 4,208,000
(oversizing to serve	47	32,900																		
up to Gold Creek in the future	57	171,000																		
and oversizing South to serve	52	78,000																		
Marymoor in future)																				

TASK 4.20 - DISTRIBUTION SYSTEM COSTS - ANNUAL O&M COSTS

			ANNUAL PUMPING STATION O&M COSTS[a]															ANNUAL PIPELINE O&Ma	
Project	Average volume MGD	Total Piping L (ft)	Total pump sta. construction costs, $	annual pump maintenance costs, 1995 US$	TDH ft	overall pump efficiency, %	annual power req's @ peak flow, kw-hr	annual pump usage, %[a]	actual annual power req's, kw-hr	cost per kw-hr, $	annual pump power cost, 1995 US$	peak flow annual labor req's, hrs	annual usage %[a]	actual annual labor, hrs	labor cost $/hr	annual pump O&M labor cost, $	Total annual pump O&M costs, $	Total pipeline construction costs, $	annual pipe maintenance costs, 1995 US$
Sammamish River Ph I	2.05	7,700	780,563	3,903	152	75%	475,965	42%	198,477	0.034	6,748	600	42%	250	45	11,259	21,910	677,936	3,390

a. Assumes irrigation operations 5 months/year.
b. It is assumed that reclaimed water is entirely stored at Willows Run, in its existing ponds.
c. ENR Sept-1995, Seattle area, construction =5800
d. ENR Feb-2000, Seattle area, construction = 7151

K 4.20 - DISTRIBUTION SYSTEM COSTS - ANNUAL

Project	ANNUAL STORAGE O&M[b]		Total annual distribution system O&M costs, $/year	After ENR Cost Indexation [c,d] $2,000
	Storage tank Construction costs, $	annual storage tank maint. costs, $		
Sammamish River Ph I	1,069,540	5,348	30,647	$ 38,000

TASK 4.20 - TERTIARY TREATMENT CAPITAL COSTS
CLASS A RECLAIMED WATER TREATMENT SYSTEM

		FILTER CHEMICAL FEED SYSTEM			FILTER FEED PUMPS											FILTERS									
Project	Plant capacity MGD	Alum/polymer feed syst. constr cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Friction head loss, ft	static head ft	TDH ft	Base pump sta. constr, $	Mob/ Demob, 0%, $	Contin-gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Total feed pumps constr cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Filter loading rate gpm/sf	Filter surface area, sf	Base filter constr. cost, $	Mob/ Demob, 0%, $	Contin-gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Total filter constr cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $
Sammamish River Ph I	3.18	720,000	252,000	972,000	10	20	30	162,000	0	40,500	0	17,415	219,915	76,970	296,885	3.5	631	1,710,000	0	427,500	0	183,825	2,321,325	812,464	3,133,789

a. ENR Sept-1995, Seattle area, construction =5800
b. ENR Feb-2000, Seattle area, construction = 7151

SK 4.20 - TERTIARY TREATMENT CAPI
ASS A RECLAIMED WATER TREATMEI

	CHLORINATION SYSTEM CONSTRUCTION COST											CHLORINE TANK CONSTRUCTION COSTS												After
Project	Chlorine dosage, mg/l	Chlorine peak use, lbs/day	Cl system base constr cost, $	Mob/ Demob, 0%, $	Contin- gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Cl system cost w/o UFC upgrade	Cl system cost w/UFC upgrade, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Cl tank det. time, min	Cl tank vol, cf	Cl tank base constr cost, $	Mob/ Demob, 0%, $	Contin- gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Total Cl tank cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Total Project Cost, $	ENR Cost Indexation[a,b] $2,000
Sammamish River Ph I	5	133	80,000	0	20,000	0	8,600	108,600	217,200	76,020	293,220	35	10,331	198,000	0	49,500	0	21,285	268,785	94,075	362,860	5,058,754	$ 6,238,000

TASK 4.20 - TERTIARY TREATMENT O&M COSTS
CLASS A RECLAIMED WATER TREATMENT SYSTEM

		ALUM CHEMICAL COSTS[a]						POLYMER CHEMICAL COSTS[a]						ALUM/POLYMER FEED SYSTEM POWER				ALUM/POLYMER O&M		TOTAL	FILTER O&M	
Project	Average capacity	Alum dosage,	Alum use,	Annual use,	Annual vol,	Alum cost,	Annual alum	Polymer dosage,	Polymer use,	Annual use,	Annual vol,	Polymer cost,	Annual Polymer	alum/polymer feed power	annual power req's	cost per kw-hr,	annual pump power	Alim/polymer feed syst.	O&M costs,	ALUM/ POLYMER	Total Filter const	O&M costs,
	MGD	mg/l	lbs/day	%	tons	$/ton	cost, $	mg/l	lbs/day	%	tons	$/ton	cost, $	req's, hp	kw-hr	$	cost, $	const cost,$	$	O&M, $	cost, $	$
Sammamish River Ph I	2.05	150	2566	42%	195	140	27,343	0.5	8.55	42%	0.65	4,000	2,604	2.5	16,286	0.034	554	720,000	3,600	34,101	2,321,325	11,607

a. Assumes irrigation operations 5 months/year.
b. ENR Sept-1995, Seattle area, construction =5800
c. ENR Feb-2000, Seattle area, construction = 7151

K 4.20 - TERTIARY TREATMENT O&M COSTS
SS A RECLAIMED WATER TREATMENT SYST

	FILTER LABOR[a]					FILTER POWER			TOTAL	FILTER FEED PUMP POWER[a]							FILTER FEED PUMP LABOR[a]					FILTER FEED O&M		TOTAL
Project	Filter labor, hrs/year	annual usage %	actual annual labor, hrs	labor cost $/hr	annual Filter labor cost, $	Filter power use, kwh/year	cost per kw-hr, $	annual Filter power, $	FILTER O&M COST, $	Filter TDH, ft	overall pump efficiency, %	annual power req's @ peak flow, kw-hr	annual pump usage, %	actual annual power req's, kw-hr	cost per kw-hr, $	annual pump power cost, $	peak flow annual labor req's, hrs	annual usage %	actual annual labor, hrs	labor cost $/hr	annual pump O&M labor cost, $	Total feed pumps constr cost, $	O&M costs, $	FILTER FEED SYST O&M, $
Sammamish River Ph I	3,000	42%	1,251	45	56,295	205,000	0.034	6,970	74,872	30	75%	94,014	42%	39,204	0.034	1,333	700	42%	292	45	13,136	219,915	1,100	15,568

K 4.20 - TERTIARY TREATMENT O&M COSTS
SS A RECLAIMED WATER TREATMENT SYST

	CHLORINE FEED SYSTEM O&M					CHLORINE FEED SYSTEM LABOR[a]					CHLORINE CHEMICAL COSTS[a]						CONTACT TANK		TOTAL	TOTAL	After
Project	Cl system cost w/UFC upgrade, $	O&M costs, $	Cl system power use, kwh/year	cost per kw-hr, $	annual Cl syst power, $	Cl system labor, hrs/year	annual usage %	actual annual labor, hrs	labor cost $/hr	annual Cl system labor cost, $	Chlorine dosage, mg/l	Chlorine peak use, lbs/day	Annual use, %	Annual vol, tons	Chlorine cost, $/ton	Annual Chlorine cost, $	Total Cl tank cost, $	O&M costs, $	CHLORINE SYST O&M, $	CLASS A SYSTEM O&M, 1995$	ENR Cost Indexation[b,c] $2,000
Sammamish River Ph I	217,200	1,086	13,500	0.034	459	700	42%	292	45	13,136	5	85.55	42%	6.51	200	1,302	268,785	1,344	17,326	141,867	$ 175,000

TASK 4.20 - SECONDARY TREATMENT PLANT COSTS

		SECONDARY TREATMENT PLANT								LIFT STATION									
Project	Plant capacity MGD	Base construction cost, $	Mob/ Demob, 0%, $	Contin- gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Secondary WWTP constr. cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	Lift station base costs[a,b,c] $	Mob/ Demob, 0%, $	Contin- gency 25%, $	Contractor O&P, 0%, $	Sales tax 8.6%, $	Lift station constr. cost, $	Engr/Admin /Legal, 35 %, $	Total Project Cost, $	TOTAL PROJECT COST, 1995$	After ENR Cost Indexation[b,c] 2000$
Sammamish River Ph I	3.18	8,800,000	0	2,200,000	0	946,000	11,946,000	4,181,100	16,127,100	83,500	0	20,875	0	8,976	113,351	39,673	153,024	16,280,124	$ 20,073,000

a. Since the Sammamish River project would be located at the York pumping station,
it is assumed that the existing pumps will be used and that a complete new lift station would not be needed. It is assumed that 10 percent of the estimated cost will be needed to provide for piping connections and associated modifications.
b. ENR Sept-1995, Seattle area, construction =5800
c. ENR Feb-2000, Seattle area, construction = 7151

TASK 4.20 - SECONDARY TREATMENT PLANT O&M COSTS

Project	Average capacity MGD	WWTP O&M cost[a], $	Lift Sta O&M cost, $	Total O&M cost, $	After ENR cost Indexation[b,c] $2,000
Sammamish River Ph I	2.05	125,050	33,500	158,550	$ 196,000

a. Assumes irrigation operations 5 months/year.
b. ENR Sept-1995, Seattle area, construction =5800
c. ENR Feb-2000, Seattle area, construction = 7151

1-Sammamish River Project (Phase I)

CALCULATION OF LEVELIZED UNIT COSTS

Design Flow =	3.18	Discount Rate =	3%
Average Flow, MGD =	2.05	Interest Rate for Debt Service =	6.25%
Distribution Length, ft =	7,700	Life Cycle, years =	35
Water Quality Class =	A	Irrigation period, months/yr =	5

	CAPITAL COSTS, 2000 $[a]				O&M COSTS, 2000 $					Salvage Value, 2000 $[e]								
Year	Distribution	Tertiary	Secondary	Total[c]	Distribution	Tertiary	Secondary	Operating capacity	Total O&M costs, 2000 $	Distribution	Tertiary	Secondary	Annualized Debt Service, 2000 $[b]	Annual Cash Flow, 2000$	Annual Cash Flow P.Worth, 2000 $	CCF produced per Year	Equiv. Annual Costs, 2000 $	Annual unit cost, $/CCf
1	(4,208,000)	(6,238,000)	(20,073,000)	(30,519,000)				0%	0				(2,167,071)	(30,519,000)	(30,519,000)	0	(2,103,952)	N.A.
2					(38,000)	(175,000)	(196,000)	50%	(204,500)				(2,167,071)	(204,500)	(192,761)	208,990	(2,247,172)	(10.8)
3					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(374,293)	417,980	(2,392,177)	(5.7)
4					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(363,391)	417,980	(2,334,414)	(5.6)
5					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(352,807)	417,980	(2,278,334)	(5.5)
6					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(342,531)	417,980	(2,223,888)	(5.3)
7					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(332,554)	417,980	(2,171,027)	(5.2)
8					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(322,868)	417,980	(2,119,706)	(5.1)
9					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(313,464)	417,980	(2,069,879)	(5.0)
10					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(304,334)	417,980	(2,021,504)	(4.8)
11					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(295,470)	417,980	(1,974,538)	(4.7)
12					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(286,864)	417,980	(1,928,940)	(4.6)
13					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(278,509)	417,980	(1,884,670)	(4.5)
14					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(270,397)	417,980	(1,841,689)	(4.4)
15					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(262,522)	417,980	(1,799,960)	(4.3)
16					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(254,875)	417,980	(1,759,447)	(4.2)
17					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(247,452)	417,980	(1,720,113)	(4.1)
18					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(240,244)	417,980	(1,681,926)	(4.0)
19					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(233,247)	417,980	(1,644,850)	(3.9)
20					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(226,453)	417,980	(1,608,855)	(3.8)
21					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(219,858)	417,980	(1,573,907)	(3.8)
22					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(213,454)	417,980	(1,539,978)	(3.7)
23					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(207,237)	417,980	(1,507,037)	(3.6)
24					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(201,201)	417,980	(1,475,055)	(3.5)
25					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(195,341)	417,980	(1,444,005)	(3.5)
26					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(189,651)	417,980	(1,413,859)	(3.4)
27					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(184,127)	417,980	(1,384,592)	(3.3)
28					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(178,764)	417,980	(1,356,176)	(3.2)
29					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(173,558)	417,980	(1,328,589)	(3.2)
30					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(168,503)	417,980	(1,301,804)	(3.1)
31					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(163,595)	417,980	(1,275,800)	(3.1)
32					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(158,830)	417,980	(1,250,554)	(3.0)
33					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(154,204)	417,980	(1,226,043)	(2.9)
34					(38,000)	(175,000)	(196,000)	100%	(409,000)				(2,167,071)	(409,000)	(149,712)	417,980	(1,202,245)	(2.9)
35					(38,000)	(175,000)	(196,000)	100%	(409,000)	1,795,413	1,663,467	5,352,800	(2,167,071)	8,402,680	2,986,173	417,980	1,952,384	4.7
													Total:		(35,585,900)	14,002,317	(57,134,300)	
																	Levelized Unit Cost in 2000 $, $/ccf[d,f]:	**(4.08)**

a. It is assumed that 80% of the distribution system facilities and 50% of the treatment facilities are considered static facilities with a 35 years useful life. To be consistent with the Regional Wastewater Services Plan (RWSP), replacement of non static facilities is assumed after 35 years of operation.

b. Assumes a 6.25% interest rate for annualized capital recovery with equal payments over 35 years.

c. Assumes the use of the existing York pumping station pumps; if a complete new lift station were needed, secondary treatment capital costs would be $ 21,771,000, for a total capital cost of $31,637,000.

d. Levelized unit cost with new package lift station would be $ 4.21/ccf.

e. Salvage value based on static facilities having a 75-year useful life, using straight line depreciation.

f. Levelized unit cost with constant reclaimed water production of 3.18 mgd instead of 2.05 mgd would be $ 2.81/ccf.